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Efficiency wages in low-wage labour markets and the economic effects of the minimum wage

Efficiency Wages in Low-Wage Labour Markets and the Economic Effects of the Minimum Wage

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Abstract

The aim of the thesis is to investigate the validity of efficiency wages theory in low-wage labour markets and to analyse the economic effects of minimum wages under an efficiency wage framework

We extend the efficiency wages shirking model of Shapiro and Stiglitz (1984) that was suitably modified by Rebitzer and Taylor (1995) to predict the effects of the minimum wage on employment, by endogenising supervision intensity and we show that the fundamental prediction of the seminal efficiency wages models of a positive minimum wage employment hinges critically on simplified assumptions and is not robust to changes in these assumptions.

In particular, we show that the positive employment effect of the minimum wage predicted by the model of Rebitzer and Taylor (1995)and the model of Calvo and Wellisz (1979) hinges on the assumption of fixed supervision and the assumption of constant returns to scale respectively and when these critical assumptions are relaxed the employment effect is zero or negative and ambiguous respectively. Our extension of the shirking model can generate more accurate predictions of the employment effects of the minimum wage, that also better reconcile with recent and important empirical evidence from low wage labour markets.

The second contribution of the thesis is that it provides new evidence on the empirical relevance of efficiency wages by presenting a credible attempt to test the wage/supervision trade-off prediction of efficiency wage models, using establishment level data from the 1990 UK Workplace Industrial Relations Survey (WIRS). Our findings support the main

tenet of efficiency wages that higher wages are positively correlated with unskilled manual employees' productivity. The interpretation of this evidence suggests that efficiency wages cannot be ruled out in favour of alternative labour contracts, for low-wage workers.

We also provide an empirical analysis of the effects of the UK National Minimum Wage (NMW) introduction and subsequent increases in a very low-wage sector, the residential care homes industry. The introduction of the UK National minimum wage provides an ideal setting to test the efficiency wage prediction of a wage-supervision trade-off using the data from a very low-wage labour market and enable us to identify more clearly the relationship between wages and supervision, by addressing the main problems that hinder the estimation of this relationship. The evidence produced is consistent with a trade-off between wages and supervision.

Finally, the evidence on the employment effects of the NMW introduction and increase in the care homes sector is consistent with the predictions of our theoretical model, and the evidence on the NMW effects on other labour market outcomes in the sector seem to provide support to theoretical models of efficiency wages, and thus the overall findings seem to suggest that the NMW may have operated as an efficiency wage in the UK care homes sector.

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Author's Declaration

I declare that the work in this dissertation was carried out in accordance with the Regulations of the University of Bristol. The work is original, except where indicated by special reference in the text, and no part of the dissertation has been submitted for any other academic award. Any views expressed in the dissertation are those of the author.

Signed: Date: 21/7/06

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Chapter 1
Introduction

...highly paid labour is generally efficient and therefore not dear labour; a fact which thought it is more full of hope for the future of the human race than any other that is known to us, will be found to exercise a very complicating influence on the theory of distribution. **Alfred Marshall, Principles of Economics. 1920**

Low Wages are by no means identical with cheap labour. From a purely quantitative point of view the efficiency of labour decreases with a wage which is physiologically insufficient... the present-day average Silesian mows, when he exerts himself to the full, little more than two-thirds as much as land as the better paid and nourished Pomeranian or Mecklenburger, and the Pole, the further East he comes from, accomplishes progressively less than the German. Low wages fail even from a purely business point of view wherever it is a question of producing goods which require any sort of skilled labour, or the use of expensive machinery which is easily damaged, or in general wherever any greater amount of sharp attention of initiative is required. Here low wages do not pay, and their effect is the opposite of what was intended. **Max Weber, The Protestant Ethic and the Spirit of Capitalism (Scribner, New York, 1925, p. 61)**

The second and offsetting result, the increase in labor productivity might come in one of two ways: the laborers may work harder or the entrepreneurs may rise different production techniques. The threat of unemployment may force the inefficient laborers to work harder (the inducement of higher earnings had previously been available and failed) *but this is not very probable. These workers were already driven by the sharp spurs of poverty and for many the intensity of effort must be increased beyond hope (up to 50 or more per cent) to avoid discharge.* **George Stigler. The Economics of Minimum Wage legislation (American Economic Review, 1946, vol. 36, p. 359)**

A careful reader has by now noticed that under cover of summarizing what we know about the minimum wage, I have focused instead on areas where our understanding comes up short. Filling in these gaps is not easy: if it were, they would not have remained as gaps... Progress in filling these gaps will also improve our general knowledge of how labor markets-or at least low-wage labor markets- work: and that may well be the largest payoff to the effort. **Charles Brown, Minimum Wages, Employment and the Distribution of Income, (The Handbook of Labor Economics, 1999, vol. 3, p. 2158)**

1.1 The Standard Competitive model and its limitations

The neoclassical model of perfect competition is unambiguously the most popular analytical framework that economists adopt in order to understand and explain the operation of the labour market. Probably the main reason why this is the case is the analytical simplicity of the competitive model of the labour market which renders it convenient for empirical analysis. The dominant position of the competitive model in the economics of labour markets can be easily demonstrated by the fact that almost all labour economics textbooks devote a significant part of their analysis to the neoclassical model.

However, most of the recent developments in labour economics are mainly based on the view that the standard textbook model doesn't provide a good approximation to labour market reality and the operation of firms (Card and Krueger 1995, Manning 2003). This skepticism about the analytical power of the standard model has a long tradition in labour economics that pre-existed the emergence of the Chicago school of thought and the dominance of the neoclassical thinking in mainstream economics (Manning 2003).

The main weaknesses and limitations of the standard model stem from its fundamental assumptions that describe the nature and the main features of the labour market, which also determine the model's predictions.

Based on the neoclassical view, the labour market is a perfectly flexible and frictionless market, because there are no adjustments and mobility costs and that is why employers adjust instantaneously in exogenous shocks and workers are perfectly mobile. (Ehrenberg and Smith 2000). The perfect flexibility of employers and mobility of workers is also the result of perfect information in both sides of the labour market, an assumption with a number of important implications. In particular, the implication of the absence of adjustment and mobility costs and of perfect information is that firms have no discretion on the wages they pay, as any attempt to change wages will have as a result a dramatic change in employment at the firm level. This latter condition is simply translated in economics language as that the elasticity of labour supply at the firm level is perfectly (infinitely) elastic, which further means that if an employer decides to cut wages by a penny then all his/her workforce will leave the firm.

Finally, the neoclassical model is based on the fundamental behavioural assumption of economic rationality according to which economic agents (firms and workers) act so that to maximise their individual 'well-being', and that is why they rank all feasible actions in terms of their associated benefits and they choose to undertake the action with the maximum benefit (Autor 2003). This simply implies that firms exploit any possibility for higher profit and operate at peak efficiency and that workers freely move to another job if the pay or overall benefits are higher (Card and Krueger 1995).

The main implication of the above assumptions of the standard textbook model is that wages are determined by workers' productivity but also by job and firm attributes, that make a job more or less desirable to employees (Rosen 1986). This prediction of the model is known as the 'law of one wage' simply implying that the wage of workers with the same productivity will be the same across all firms, and any wage dispersion for productively identical workers can only be attributed to workers preferences about job and firm's characteristics and working conditions (Rebitzer 1989).

Nevertheless, there are many observations and regularities as well as empirical evidence that challenge the ability of the competitive model to describe the nature of labour markets as well as to explain the main observed phenomena in these markets. In particular, wages and employment seem to flunctuate less than the perfectly smooth and frictionless operation of the labour market view of the competitive model predicts and wage cuts are extremely rare (Milgrom and Roberts 1992). In reality labour markets are not frictionless. Labour mobility is quite limited simply because of imperfect information, heterogeneous preferences and mobility costs and that is why studies of labour mobility seemed to show that workers were extremely reluctant to change jobs and hence that the mechanism which was imagined to enforce the competitive law of one wage, in reality, is much weaker than labor economists imagined (Manning 2003).

As discussed previously, a result of perfect labour mobility is that firms take the wage as given or that labour supply at the firm level is perfectly elastic and that is why employers that marginally cut wages lose all their workforce, a rather extreme prediction (Dolado et al. 1996). As the view of a frictionless labour market is a synonym of the fact that the wage is given at the firm level and of a perfectly elastic firm labour supply, the existence of frictions would imply that labour supply at the firm level is not perfectly elastic and thus employers have some wage setting power.

Indeed, the existence of frictions seems to be the rule rather than the exception in economic models of the product market as suggested by the industrial organisation literature where the bulk are models of imperfect competition where employers have some price setting power (Bhaskar, Manning and To 2002, Manning 2003). Frictions are expected to be even more important in labour markets than product market as it is expected that "it is more costly for one to change job than super market" (Manning 2003). Moreover, assuming that labour markets are not frictionless is consistent with workers and employers perceptions of the operation of labour markets, as for example workers report events of changing a job as major life events and employers behave as having some discretion over the wages they pay, as indicated by personnel and human resource policies and practices which treat wages as a very important instrument in recruiting, retaining and motivating employees (Manning 2003).

Additionally, the assumption of perfect information doesn't seem to be very appropriate for the labour market, as imperfect and private information are pervasive features in this market with significant implications for the surplus generated by labour market transactions. For example employers do not observe workers productive capacity, quit propensity and effort and that is why they expend a considerable amount of energy and resources in sorting potential employees, regulating turnover and designing incentives for existing workforce. The last three operations consist probably the most important elements of personnel policy and human resources managerial strategy of the firm. In contrast, if the competitive model was true and thus information in the labour market was perfect then human resource managers shouldn't worry about recruitment, retention and motivation as long as they pay the market wage. This argument seems to provide further support to the view that the standard model presents a simplistic view of labour markets.

Furthermore, there is evidence (Kahneman, Knetsch and Thaler 1986) that other aspects of the employment relationship as perception of fairness and ability to pay are important determinants of employees and employers decisions, a feature which is again at odds with the neoclassical assumption of economic rationality. Therefore, as suggested above the fundamental assumptions of the competitive model implicitly rule out a number of other behaviours that may be important in understanding the workings of the labour market (Card and Krueger 1995).

However, economists believe that economic models should not be judged by the realism of their assumptions but mainly by their ability to explain observed phenomena. Even under this perspective there is evidence that the standard textbook model provides an inaccurate picture of labour markers. Two of the most pervasive phenomena in the labour market are involuntary unemployment and wage dispersion.

By involuntary unemployment we define the situation where workers that want to work for the market wage cannot find a job. This phenomenon cannot reconcile with the competitive model, according to which involuntary unemployment is a synonym of excess labour supply which leads to a fall in wages and market clearing. Thus, involuntary unemployment cannot exist in a world consistent with the neoclassical view and the main competitive explanations of this phenomenon are exogenous interventions as unions and minimum wages that prevent wages to fall and the labour market to clear.[1] However, there is evidence that does not seem to support the latter explanation, as involuntary unemployment is also observed in labour markets with no minimum wage or trade unions (Manning 2003) and it has been also observed that unemployment persisted even in times that were characterised by a decline in unionisation internationally and in the real value of the minimum wage (Rebitzer 1989).

Moreover, under the competitive framework, as also suggested above, wages depend only on worker's productivity and on attributes of firms or jobs that make jobs less desirable. Workers mobility and perfect information would arbitrage away any wage differential that are not related to worker's productivity and compensating wage differentials (Ritter and Taylor 1997).

In reality wage dispersion for seemingly identical (in productivity) workers is a well documented fact in labour economics (Ehrenberg and Smith 2000). In particular, there is much evidence that wage differentials are correlated with a range of employer characteristics mainly industry affiliation (Krueger and Summers 1988, Gibbons and Katz 1992),

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[1] The existense of vacancies is another phenomenon that cannot reconcile with the standard's textbook view of frictionless labour markets.

employer size (Brown and Medoff 1989, Brown et al. 1990, Oi and Idson 1999), profits or profits per worker (Revenga 1992, Abowd and Lemieux 1993, Blanchflower et al. 1996, Hildreth and Oswald 1997) and firm's productivity (Nickell and Wadhwani 1990).

The above evidence have been interpreted as that the labour market is not competitive. However, there is also considerable debate as to whether the observed wage structure can be explained in terms of the neoclassical reasoning of unobserved workers' quality and compensating wage differentials. The bulk of the evidence seems to suggest that the competitive explanations cannot account for a substantial portion of the observed wage structure and that is why alternative non-competitive theories have been developed and used to explain the observed findings.

For example, the evidence suggests that the employer size wage effect does not vanish even after accounting for unobserved ability differences and differences in working conditions as working conditions indicators suggest that larger firms are considered as better places to work by employees and that quit rates are lower in larger firms (Manning 2003). In general it also true that compensating wage differentials have not proved of great value in explaining wage variation. The basic problem is that it is hard to find evidence that, other things being equal, more unpleasant jobs are rewarded with higher wages. Often it seems that better-paid jobs have better working conditions. The most common explanation for these anomalous findings is unobserved worker ability. However, it is not clear that this is the root of the problem as economists (Brown et al. 1990) found that even when panel data are used to control for individual fixed effects (which we might expect to pick up unobserved ability) it is still hard to find evidence for compensating wage differentials (Manning 2003).

In conclusion, we do not argue that the competitive model is wrong and that is why it should be dismissed. Our main objective is to show that either using as a criterion the realism of the assumptions or the ability of the model to reconcile with empirical findings it is not clear why most of labour economics have been based on the neoclassical model and why economists' have been so reluctant to replace the simple model from the back of their heads with more flexible theories that adopt a more open minded view of the operation of the labour market.

1.2 The Neoclassical View of Low-Wage Labour Markets and the Economic Effects of the Minimum Wage

The above discussion highlights the main points of criticism produced in recent years on the ability of the competitive model to provide a unified analytical framework that describes the nature of labour markets and that accurately predicts observed phenomena in these markets. Based on the standard arguments presented above the same criticism applies also on the ability of the standard model to provide insight on the workings of low-wage labour markets in particular, which are the main focus of this thesis.

As far as the operation of low wage labour markets is concerned, the incompleteness of the neoclassical model can be better demonstrated by a brief review of the evolution of the labour economics literature in the topic of minimum wages, a topic which is closely linked to the validity of the competitive framework (Card and Krueger 1995).

There are many reasons why this is the case: firstly the standard model of the labour market does not always yield clear and unambiguous predictions, making it extremely difficult to test the model. The minimum wage is an exception, however, because the standard model makes strong and unambiguous predictions about the impact of a minimum wage on employment, wages, profit and prices (Card and Krueger 1995).

Moreover, supporters of minimum wages argue that the minimum wage is an antipoverty and redistributive device that combats exploitation and reduces inequality whereas opposition to the policy is based mainly on the arguments that minimum wages destroy low wage jobs and thus increase unemployment and poverty (Dolado et al. 1996). The criticism that minimum wages reduce employment of low wage employees is a prediction of the neoclassical model and is probably one of the most heavily researched questions in the field of economics (Machin, Manning and Rahman 2003). Indeed, the negative view of the minimum wage policy among professional economists is based solely on neoclassical reasoning (Dolado, Felgueroso and Jimeno 2000).

In general, the minimum wage has always been a very popular issue in the policy agenda but also in the field of economics (Zavodny 1999). Countries around the world, including the US and most other OECD countries, maintain minimum wage laws and each time an increase in the minimum wage is discussed there is a renewed debate about the likely effects of the policy and particularly about whether minimum wages help or hurt the disadvantaged, and whether labour market functions as smoothly as economics textbooks writers assume (Card and Krueger 1995).

Furthermore, the general public favours a minimum wage introduction or increase as people view this as socially just and that is also why the minimum wage has attracted the interest of political scientists and sociologists (Card and Krueger 1995). Because of the popularity of the minimum wage with the general public and the fact that the minimum wage is administratively simple and that has no direct budgetary costs, policy makers are usually inclined to support minimum wages relatively to other transfer programs (Dolado, Felgueroso and Jimeno 2000). However, this may not always be the case, as if the attitude of a political party towards minimum wages is used as a simplistic criterion of the party's political ideology, one should expect that the minimum wage will be usually opposed by more conservative parties (Eccleshall et al. 2004).

Additionally, the minimum wage is a favorite topic for economic research as suggested by the number of published articles in the topic during the last 25 years which by far exceeds the number of published articles on other transfer programs (Hamermesh 1996). In particular, the employment effect of the minimum wage has concentrated most of the attention by professional economists, because probably the clearest and most appreciated prediction of the standard model is that an introduction/increase in the minimum wage will decrease the employment of affected workers. Economists' fascination with the minimum wage arises in large part because it provides such a clear test of the standard neoclassical model but also of the law of demand by providing the unique setting to test the effects on exogenous wage increases on labour market outcomes (Card and Krueger 1995).

The role of the minimum wage in policy agenda has been recently seriously reconsidered as the link between high growth and low poverty broke down and as there was an increase in income inequality and in the number of households with low earners that implied an association of low wages and poverty (Dolado, Felgueroso and Jimeno 2000). Moreover, recent policy discussion (OECD 1994, 1998) seem to highlight the role of the minimum wage as an important tool for employment centred social policy which provides incentives for people to flow into employment. Recent evidence, particularly from the US, also supports the view that the minimum wage tends to compress the wage distribution contributing to lower wage inequality (Meyer and Wise 1983, Card and Krueger 1995, Dinardo et al 1996, Dolado et al. 1996, Dickens et al. 1999). There is also more evidence that minimum wage earners tend to accrue disproportionately in low income households, which is against the standard minimum wage opposition argument that low wage earners are not in low income households and that the majority of poor people are unemployed (Card and Krueger 1995, Dolado et al. 1996, Marx and Verbist, 1998). Therefore, the role of the minimum wage as a redistributive tool has been also reevaluated in recent policy agenda.

Prior to the early 1990s, something of a consensus had been established about the impact of minimum wage on employment in the US (Brown 1999). The main conclusion was that, while the minimum wage had no effect on the employment of adults (because it was set too low), it did have a modest but significantly negative effect on the employment of teenagers (Manning 2003). The bulk of this evidence has been produced by time series studies summarized by Brown, Gilroy and Kohen (1982), as that a 10% increase in the minimum wage reduces teenage employment by 1 to 3%, though with no identifiable effect on the adult labour market. This view was powerfully challenged by Card and Krueger (1995) who in a series of studies (Card 1992a, Card 1992b, Katz and Krueger 1990, 1992, Card and Krueger 1994, Card and Krueger 1995) failed to find any evidence of a significant negative employment effect of the minimum wage. The new evidence generated a lot of criticism, however, more evidence from the UK (Dickens et al. 1999, Machin et al. 2003, Machin and Wilson 2004) and other European countries (Dolado et al. 1996, Dolado et. al 2000) seem to provide support to the new striking conclusion of a non-negative employment effect of the minimum wage.

The new evidence on the employment effects of minimum wages has been one of the mains reasons, together with those presented above for the renewed interest in the topic and had further important implications. Probably, the main implication was that the recent evidence casts doubt on the validity of the competitive model of the labour market, as no extension or variant of the model can explain a non-negative employment effect of the minimum wage.

Moreover, the validity of the standard textbook model is also challenged by some of the stylized facts produced by empirical studies of the effects of minimum wage. Particularly, findings of studies that investigate the effect of the minimum wage on the wage distribution report the presence of a large spike in the wage distribution at the minimum wage (Card and Krueger 1995, Brown 1999, Machin et al. 2003). The evidence suggests that the spike moves in response to minimum wage changes and becomes more prominent after a minimum wage increase as workers who formerly were paid less than the new minimum are 'swept up' to the minimum wage (Brown 1999). This pattern implies that workers who were previously paid different wages they all receive the minimum wage after the increase which is at odds with the prediction of the neoclassical model that each worker is paid according to his/her productivity.

Additionally, increases in the minimum wage also generate a ripple effect, leading to pay raises for workers who previously earned wages above the new minimum wage (Manning 2003). These so-called 'spill-over' effects of the minimum wage cannot be explained by the simple competitive model but it is possible to be explained by a suitable extension of the model (for example an extension to allow for an uncovered sector) (Brown 1999). In general, the above findings cast doubt on the validity of the competitive model, as the only effect of the minimum wage on the wage distribution predicted by the competitive model is the truncation of the distribution at the minimum wage.

Another puzzle for the standard model is the findings from minimum wage studies of the low utilisation of youth and training subminimum wage rates (Katz and Krueger 1992, Card and Krueger 1990, Machin et al. 2003) but also of the absence of systematic evidence that employers reduce non-wage benefits in order to offset an increase in the minimum wage (Card and Krueger 1995, Brown 1999). Both these findings hardly reconcile with the assumption of the competitive model that employers exploit any opportunity to minimise costs.

The simple competitive model predicts that an introduction/increase in the minimum wage will have as a result a cut in output and an increase in product prices of the affected industry. The limited available evidence suggests that minimum wage increases often lead to an increase in prices of products produced by minimum wage labour (Brown 1999). However, economists seem to be divided on the latter issue as there are many who support the view that it is not clear how the evidence of price increases and the prediction of the simple model compare[2] and others who suggest that the competitive model is in general somewhat more successful in predicting price changes as a response to a minimum wage introduction/increase (Card and Krueger 1995, Brown 1999).

According to the simple model profits at the firm and industry level are expected to decline as a result of a minimum wage increase/introduction and provided the decrease in profits some firms will be induced to exit the industry in the long run.[3] There is no systematic evidence of significant negative effects of minimum wage increases on profits as for example Card and Krueger (1995) find that the news about the impeding minimum wage increases during the late 1980s led to little or no change in the market value of low-wage employers such as restaurants, hotels and dry cleaners. Moreover, the limited evidence (Card and Krueger 1995, Zavodny 1999, Alpert 1986, Machin et al. 2003 and Machin and Wilson 2004) on the long run effects of minimum wage increases on the number of firms in affected sectors find a zero or positive effect which is hard to reconcile again with the predictions of the simple model.

The above discussion suggests that the simple competitive model cannot reconcile with the empirical evidence and the main stylized facts of the minimum wage literature. However, it is true that suitable extensions and variants of the model could explain some of the puzzles individually, but no unified explanation for the coexistence of these features can be provided by a competitive framework (Manning 2003). Furthermore, even if the

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[2] There is evidence that does not support the prediction that prices rise faster in establishments that are more affected by the minimum wage increase (Katz and Krueger 1992, Card and Krueger 1994).

[3] Provided that prices do not increase more than the increase in the average cost caused by the minimum wage increase.

competitive model could possibly reconcile with a zero employment effect of the minimum wage in the short run, no version of the competitive model can explain a positive or non-negative employment effect in the long run. The employment effects of the minimum wage is probably the most important discrepancy between the theory and the evidence.

Therefore, empirical evidence from low wage labour markets and the analysis of the economic effects of the minimum wage suggests that the low-wage labour market description offered by the elementary textbook model is quite poor.

1.3 Alternative Theories

The analysis up to now seems to suggest that there is a broad array of evidence and features of labour markets that cast doubt on the competitive view of the operation of labour markets. In reality, wage and employment determination are more complex processes than the competitive model describes. For example, neoclassical economics revisionists who thrived in the US in the 1940s and 1950s believed that fairness and ability to pay are expected to influence wages and employment (Card and Krueger 1995). A standard response to the criticism that the competitive model provides a simplistic and thus an inaccurate view of labour markets is that economic models should not be judged by the realism of their assumptions, as the objective of a model is not to capture all the nuances of the real world and that is why models abstract from reality. However, the key question is how crucial the assumptions made are for the results obtained and how much this simplifications matters.

Economists who are sceptic about the view of the labour market presented by the neoclassical model and its implications long recognised the need for the development of alternative models that may depart only slightly from the assumptions of the standard model but yet will be capable to explain a broader range of observed phenomena (Manning 2003). The development of alternative models is also important for low wage labour markets as indicated by the minimum wage literature because different models reflect different views of how low wage labour markets operate and thus generate different predictions and have different implications for policy prescriptions (Dolado et al 1996.).

There are many different classes of alternative theoretical models developed the last 20 years that deviate from the competitive framework and manage to explain some of the empirical findings which cannot be explained by the standard model. Probably the common point of deviation from the competitive model of all alternative models is that wages are not assumed to be given to the firm but instead it is assumed that employers have some wage-setting power. Following Manning's (2003) recent influential work all models where employers have labour market power can be classified under the general term of monopsony.

Manning's approach is summarised by the fact the there are important frictions in the labour market, in contrast to the competitive framework, that gives employers some power in setting wages. In particular, labour market frictions may be the result of heterogeneous preferences, imperfect information or mobility costs that have as a result that if an employer marginally cuts wages he doesn't necessarily loses all his/her workforce. This simply implies that the difference between the competitive model and monopsony is that in the latter the elasticity of labour supply at the firm level is finite.

Probably one of the most interesting implications of monopsony-kind models is that the prediction of the competitive model that a minimum wage introduction/increase will decrease employment is reversed. This is also the main reason why most of elementary textbooks in labour economics devote few pages to the simple, static model of monopsony, which is however dismissed as pure intellectual curiosity because most labour markets and especially low wage labour markets are characterised by a large number of employers and do not resemble the situation of the coal mining company in an isolated town (Ehrenberg and Smith 2000). However, as suggested above recent work has shown that monopsony and wage-setting power is not only the result of a single employer or of a large market share[4] but mainly of the presence of labour market frictions.

Different source of frictions give rise to different kind of models that generate the monopsonistic predictions. For example in the case where firms differ discretely along dimensions (location, etc.) and workers have heterogeneous preferences over firms because they have to incur (pecuniary or psychic) costs when leaving a firm, the market can be modelled as monopsonistic competition (Bhaskar and To 1999, Bhaskar, Manning and To 2002)[5],whereas the case that there is a small number of employers that collude in the labour market can be characterised as oligopsony. Monopsony can also arise when there is imperfect information in the labour market and that is why there is cost in moving between jobs for workers and costs of recruiting new workers for employers. As long as a higher wage helps firms to recruit workers the firm has some monopsony power. In a monopsony sit-

[4] In the Industrial Organisation literature large market share gives rise to price-setting power.

[5] A model where monospony arises because of mobility costs is presented by Ioannides and Pissarides (1985).

uation firms operate with ongoing vacancies. Although each employer would like to hire more workers at the current wage, it is not worthwhile to offer a higher wage, as the firm would have to pay the higher wage to all its current employees. Furthermore, different firms might choose to pay different wage rates, depending on the sensitivity of their recruiting efforts to the level of wages. Some firms might choose to offer a lower wage, and to operate with higher vacancies and higher turnover. Others might choose a higher wage, and to operate with lower vacancies and lower turnover. The latter environment is modelled by dynamic equilibrium search models, as the general equilibrium model of dynamic oligopsony presented by Burdett and Mortensen (1998), which also forms the main theoretical framework of Manning's monopsonistic approach in labour economics.

Another category of models in which the monopsony predictions can be produced are efficiency wages models (Calvo and Wellisz 1979, Manning 1995, Rebitzer and Taylor 1995). These models (which are going to be discussed analytically in the following section) differ from the above models, as wage-setting power is not generated by frictions but by the particular principal-agent theoretical setting, under which asymmetric information is the main reason why wages affect employees' productivity because for example they affect the effort and quit behaviour of existing employees or the quality of potential employees and that is why wages are set above the market clearing level.

The above categories of models that slightly deviate from the conventional framework can better reconcile with the main stylized facts of the labour market and of low wage labour markets in particular as indicated by the minimum wage literature (Card and Krueger 1995, Brown 1999). Equilibrium search models can explain why different wage policies can coexist in equilibrium, a principle that is widely accepted in the personnel field and thus more importantly why wages of workers of similar productivity differ systematically across firms. Moreover, these models can be consistent with a positive employment effect of a legislated wage floor as the minimum wage. Similarly, efficiency wage models can explain the existence of wage differentials for workers with the same productivity, the existence of involuntary unemployment, as well as the non-negative employment effect of a minimum wage as suggested by the recent empirical findings and the non-utilisation of subminimum wage provisions.

Although alternative models can explain the majority of the empirical evidence produced by capturing some of the important features of labour markets, one should recognise that many models of labour market have been developed, yet much of what occurs in that market remains a mystery to economists. Thus, a rigorous evaluation of the alternative models must await additional research (Card and Krueger 1995).

1.4 Efficiency Wage Models of the Labour Market

The thesis aims in investigating whether efficiency wages considerations are particularly valid in low wage labour markets and thus whether efficiency wages theory could provide valuable insights into the economic effects of the minimum wage. The motivation for investigating the above hypotheses is presented in the next section. In this section we are presenting a review of efficiency wages theory and its main criticism.

Efficiency wage theories have been invented in order to explain the puzzle of why wages do not fall at the microeconomic level, under excess labour supply, and why involuntary unemployment exists (Akerloff and Yellen 1986, Weiss 1990), a phenomenon that is at odds with the competitive model of the labour market, as discussed also in one of the previous sections.

As suggested above the main deviation of efficiency wage theories from the standard competitive framework is that wages are positively associated with workers' productivity (Stiglitz 1987). This association can be direct as for example in the case of less developed economies where wages influence the health, mental alertness and physical well-being of workers and thus higher wages can augment employees' labour endowment (Leibenstein 1957, Bliss and Stern 1978a, 1978b, Dasgupta and Ray, 1986, 1987). Alternatively, in developed countries higher wages increase workers' effort and thus productive capacity by boosting workers' morale (Solow 1979). Moreover, because private information of workers actions and characteristics is a pervasive phenomenon of the employment relationship, wages can affect worker's productivity via their influence on workers' motivation by their effects on effort and quits, (the incentive effect of higher wages) and/or their influence on workers' unobserved productive characteristics as higher wages may attract more productive applicants (the sorting effect of wages) (Weiss 1990). Thus, because of the latter effects of wages on worker's productivity, all efficiency wage models generate the result that it is optimal (more profitable) for employers to pay above the market clearing wage.

A variety of conceptually distinct, although potentially complimentary explanations for the relationship between wages and employees' productivity have been analysed in the literature (Katz 1986). These approaches are based on potential benefits to the firm of higher wages. The nutrition and morale models, where higher wages directly affect workers productivity by increasing labour endowment, discussed above were analysed first by Leibenstein (1957) and Solow (1979) respectively. In the shirking or effort regulation model (Shapiro and Stiglitz 1984) because of agency problems, employers would like to induce required productive behaviour and in particular to elicit effort by employees. The main mechanism they use is dismissal threats based on supervision and monitoring actions which are costly. However, dismissal does not generate a penalty for a worker if he or she is as well off as unemployed as he/she is as employed and that is why employers pay a wage premium so that the wage is above the worker's outside option (the market clearing wage) in order to generate a penalty for dismissal so that to elicit required effort, and prevent shirking.

In the turnover model of efficiency wages (Stiglitz 1974, Salop 1979) employers do not observe worker's characteristics of interest to them (quit propensity) and that is why they hire workers randomly from the applicants' pool. Worker's decision of quitting depends on the wage (as well as other aspects as for example the unemployment rate, etc.) and in particular the higher the wage the lower the quit rate and therefore firms have to choose between the low wage/high turnover strategy or a high wage/low turnover strategy. Firms with high turnover costs will optimally choose to pay a wage higher than what workers' could get elsewhere or the lowest wage required to fill open posts. In this case, a higher wage reduces turnover costs and in particular recruiting and training costs and can lead to a more experienced workforce.[6]

[6] The turnover model is similar to the dynamic monopsony or search model (Burdett and Mortensen 1998) but with the difference that the model cannot explain wage dispersion unless firms differ in their turnover costs (recruiting and training costs). The turnover model cannot only explain why equally productive workers are paid different wages but also why wages do not fall for the labour market to clear, because if firms cut wages,

The adverse selection model developed by Weiss (1980) is based on the assumption that the objective of firms is to recruit the best possible workers whose productive characteristics cannot be perfectly observed. If more productive workers have better alternative opportunities and thus higher reservation wages then the firm by paying higher wages improves the average quality of the pool of applicants from which workers are recruited and thus with more productive workers profits are higher. The firm's strategy is to choose the optimal trade-off between the higher wage and the average quality of the pool of applicants.[7]

Other seminal efficiency wages models include the 'gift-exchange' (Akerloff 1982, 1984) and the 'union-threat' (Dickens 1986) model. In the former model, the higher wage is viewed by employees as a gift that appeals to norms of reciprocity and that is why it generates higher effort and higher association of employees with the firm.[8] The 'union threat' model (Dickens 1986) is based on the assumption that there are important diseconomies of hiring and training employees.[9] Therefore, under the above conditions collective action by workers may result in the appropriation of a share of the firms' surplus. In this case the firm can prevent unionization by offering the workers the union wage and save them the costs of joining or setting up a union.

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profits will fall because of an increase in turnover costs

[7] The problem with this model is how can other employers observe workers productivity so that better productive workers have beter alternative wages when the actual employer cannot observe employees productivity.

[8] This model is similar to the effort regulation-shirking model but the behavioural foundations are based on a sociological perspective where wages affect worker's behaviour through the effects on social norms (Akerloff 1984) and not through their effects on the marginal benefits and costs of employees' effort choice.

[9] This is because the more workers are needed to be hired and trained, the fewer are the senior employees that could recruit and train the new workforce and that is why recruitment and training costs are increasing in an increasing rate with the number of hires.

The main criticism against the efficiency wage theory is that there exist other devices that solve the problem of asymmetric information which are more efficient than efficiency wages (Carmichael 1985). In fact the efficient way to solve the problem of motivation proposed in the literature is bonding (Carmichael 1985, 1987), where employees are required to pay an entry fee to the firm that is forfeited if they quit or caught shirking.[10] Bonding can be explicit where employees pay the required fee to the firm or implicit a situation that resembles actual compensation plans. In implicit bonding employees are paid a wage that is below their marginal productivity at their first years with the firm but their wages increase with seniority so that to receive more than their marginal productivity in later years and so that the present discounted value of their compensation toward their working lives equals the present discounted value of the workers' marginal product (Lazear 1979, 1981). The latter situation is also known as upward sloping tenure-earnings profiles, which leads to the efficient (full information outcome) and that is why it should be always preferred to efficiency wages.

Although bonding is the first best solution, barriers to implement it open the door to alternative solutions as efficiency wages (Katz 1986, Weiss 1990). There have been many limitations to bonding suggested in the literature. First of all workers may lack the resources necessary to post a bond and capital market imperfections may limit the extent that they can finance performance bonds by borrowing. The case of outside (bank) financing of performance bonds is also problematic as the fall in utility of workers when they lose their jobs may be lower than in the non-bank finance case, if the worker defaults

[10] Bonds can be paid back as lump sum upon retirement, as an annuity or pension after retirement and/or as higher wages paid most commonly towards the end of one's career (Katz 1986).

when fired and thus does not have to pay the interest in the loan. If workers default when fired, not only bank financed performance bonding accentuate the incentive and adverse selection problems but banks are also unlikely to finance performance bonds for workers. Thus, bank financed performance bonds will increase the probability of quitting or shirking (Weiss 1990).

Another criticism associated with bonding is that workers may be sufficiently risk-averse so that if charged with a large bond they become indifferent between employment and unemployment. Steeper tenure-earnings profiles are far more common through low wage apprenticeship programs. However, sometimes it may be the case that adequate life incentives require the payment of negative wages initially. In other words it is not always possible to tilt the path of wages in order to provide incentives (Rebitzer 1989). There may also exist legal restrictions to bonding. In particular American and English common law, courts refuse to enforce contract provisions they interpret as penalties (as distinct from damages). Courts will typically not enforce contracts in which workers forfeit bonds that are disproportionately large (Ritter and Taylor 1997).

Bonding also suffers from moral hazard problems as employers will have an incentive to fire workers in order not to repay the bond or to pay wages above worker's marginal product. In this case, reputation concerns may mitigate the morale hazard problem (MacLeod and Malcomson 1989). Nevertheless, except that reputation costs are not expected to be significant in a competitive labour market (Katz 1986), the difficulty of potential workers in verifying the honesty of a firm's behaviour means that the reputation mechanism is quite fragile and may be a far from perfect enforcement mechanism (Ritter and Taylor 1997).

It is important to note that bonding is the efficient mechanism that can be used in the case of agency problems but not in the case of adverse selection[11] and nutrition, which may further mean that bonding and efficiency wages are not mutually exclusive. An observation that supports this view may be provided by the fact that firms expend a considerable amount of resources in monitoring,[12] which further suggests that bonding should be limited as with bonding no resources are expected to be engaged in monitoring,[13] and that is why efficiency wages could be also used together with monitoring (Dickens, Katz and Lang 1986).

Manning (2003) argues that a final problem with the use of entrance fees is that a lot of information is needed to set them. In particular, the employer needs to know the value of the job to employees when they are paid their marginal product which further implies that information on workers quit rates is needed, which is often difficult for employers to obtain.

Milgrom and Roberts (1992) suggest that when incentive contracts are feasible they should be preferred to efficiency wages on the basis of efficiency, as these contracts achieve an optimal trade-off between risk-sharing and incentives. By incentive contracts we actu-

[11] An exception is the model of Salop and Salop (1976) where steeper tenure-earnings profiles can be used to screen out applicants with high propensity to quit. However, bonding cannot be used to sort out employees based on productive ability.

[12] Cursory inspection of almost any workplace indicates that firms expend substantial resources monitoring workers. Firms hire supervisors, auditors, inspectors and testers. The pace of man jobs is monitored by machines (Katz 1986).

[13] Some monitoring is required with either bonding or efficiency wages since it is useless to make it costly for workers to be caught cheating if they are never caught. Monitoring by itself cannot deter malfeasanse since there must be some cost to workers of being caught. Considering only the size of the bond and monitoring expenditures, the firm faces an optimal law enforcement problem in which it must choose the amount of resources to devote to catching malfeasants and the punishment to inflict on those it catches. The solution to this problem is that the firm will be always willing to decrease monitoring and increase the value of the bond as monitoring is costful whereas bonding is not, and thus at the limit no or minimum resources will be spend on monitoring. This is because, the same degree of deterrence can always be attained at lower cost by increasing the bond and reducing the level of monitoring. Thus, the efficient bonding solution involves no expenditure in monitoring.

ally mean the situation when employees compensation is tied to outcomes as for example piece-rate contracts used in manufacturing, where pay is tied to output, commission based pay of sales people, etc. A standard problem with incentive contracts is that risk-averse employees may be unwilling to accept them as these contracts introduce random variation in pay of employees because of the randomness associated with actual outcomes and their chosen measures. This argument is supported by the observation that the vast majority of compensation contracts are time-based (Ehrenberg and Smith 2000).

A pervasive problem in firms that tie pay to some objective measure of an outcome is that they often get exactly what they pay for: that is behaviour that changes the measure of output rather than the outcome itself (Ritter and Taylor 1997). Fraud and accounting tricks often allow employees to manipulate the output measurement without changing output. Moreover, according to Milgrom and Roberts (1992) if it is important for the firm that workers perform several tasks, incentives must be finely balanced to ensure that all the tasks get adequate attention. This is because if one task is measured whereas another is not it will be impossible without designing incentives also for the second task to make the worker to perform well in the second. Thus, for example easily observable quantity may rise at the expense of quality. Sometimes firms may not use piece rates even if they are feasible as Holmstrom and Milgrom (1994) conclude that the use of low powered incentives within the firm, while lamented as one of the major disadvantages of internal organisation is an important vehicle for inspiring cooperation and coordination. Finally, incentive contracts cannot be used to tackle situations of adverse selection or nutrition as in the case of efficiency wages.

Another way to provide incentives is by promoting the best performers to higher-paying jobs based on a particular kind of comparative performance evaluation. The workers are effectively ranked on the basis of their relative performance, and the winners get promoted whereas the losers are passed over. Given, the pay at each level this system creates a tournament (Lazear and Rosen 1981, Malcomson 1984). Tournaments can also achieve the perfect information efficient outcome, as steeper tenure-earnings profiles, if the present discounted value of wages paid towards the working lives of constantly promoted employees equals the present discounted value of their marginal product. The only difference with the steeper tenure profiles is that rewards are offered on the basis of relative and not actual performance and that high expected future income comes from the chance of promotion rather than increasing pay in the current job.

There are many advantages and disadvantages associated with tournaments. As far as the main advantages offered in the literature (Weiss 1990, Milgrom and Roberts 1992) tournaments may be preferred to incentive contracts because they are based on ordinal relative performance which is easier to measure. For example, this is because when there is a large common random element affecting employees performance, looking at relative performance eliminates the common factors and so permits better inferences. Moreover, tournaments can avoid the problem of cheating by employer that may occur in the case of bonding by using fixed number of prizes that will be definitely awarded according to the relative rankings of existing workers.[14]

[14] Firms that have the incentive to avoid filling the slots at all they will suffer from vanishing incentives as this situation is easily observed by workers so it would quickly destroy the incentive effects of tournaments.

A reason why firms would be reluctant to offer a tournament wage schedule is that it is costly to measure the productivity of workers across different jobs and to rank these workers and thus ranking may be based over race, sex, age and other forms of discrimination. Even in the absence of legal recourse, if workers view tournaments as inherently risky and susceptible to manipulation by managers favouring their friends, firms offering tournament wage schedules would need to offer higher expected wages in order to attract workers (Ritter and Taylor 1997). This compensating differential coupled with the costs of ranking workers might make a tournament wage schedule less profitable than an appropriately chosen fixed wage (Weiss 1990). Another, problem of tournaments similar to inventive contracts is that the firm gets what it pays for is that promotions are based in relative evaluations and workers may collude to reduce output or spend time sabotaging each other's chances for promotion rather than working (Ritter and Taylor 1997). Finally, another criticism against tournaments is that, as in the case of steeper tenure-earnings profiles and incentive contracts, even if tournaments are feasible they can only offer solution to incentive problems but not to problems as nutrition and adverse selection.

In conclusion, the main criticism against efficiency wages is that they are the result of arbitrary restrictions to the forms of contracts employers can offer (Manning 2003). Many characteristics of labour markets seem to support the view that restrictions to labour contracts are present. In particular, in practice evidence strongly suggests that there are binding constraints in the implementation of efficient labour contracts. In particular, evidence strongly suggests that there are valid limitations that prevent employers to behave as perfectly discriminating monopsonists and that is why simple models where employers set a single wage do not seem to offer a bad approximation of reality (Manning 2003). All the above arguments and evidence may further imply that efficiency wages may arise as the optimal contract in many labour markets.

1.5 Efficiency Wages, Low Wage Labour Markets and the Minimum Wage

In the previous section we presented the main theoretical arguments for and against the validity of efficiency wages theory. In the current section we are interested in analyzing the reasons that suggest why the efficiency wage theory may be particularly relevant for low wage labour markets, and thus why efficiency wages could provide valuable insight into the economics effects of minimum wage laws.

Efficiency wages have also been offered as an explanation of dual (segmented) labour markets (Katz 1986) where the entire labour market is roughly divided in two sectors; the primary sector which is characterised by internal labour markets,[15] long-run employment relationships and higher wages, whereas the secondary sector is characterised by the absence of internal labour markets, short-term employment relationships that hold no promise of promotion and where wages are fully determined by market forces (Milgrom and Roberts 1993, Ehrenberg and Smith 2000). The secondary labour market includes menial jobs which are characterised by low earnings, easy entry, job impermanence and low

[15] As internal labour market is characterised the relationship between a firm and its long-term employees with main characteristics limited ports of entry for hiring, career paths within the firm and promotions from within.

returns to education or experience. Based on the latter analysis, the secondary sector can be viewed as synonym of low-wage labour markets.

Under internal labour markets because the employment relationship has longer term horizon efficiency wages are more effective (Milgrom and Roberts 1992) but also bonding and incentive contracts as employees' performance can be assessed more accurately in the long-run (Rebitzer 1989).

Bulow and Summers (1986) and Jones (1985) suggest that the rational for dual labour markets is provided by the shirking model of efficiency wages where monitoring in the primary sector is costly and difficult and that is why wages are above the market clearing level and the sector is characterised by job rationing, whereas in the secondary sector monitoring should be close to perfect and that is why this sector clears. This view may be supported by the empirical observation that the typical primary job entails a fair degree of responsibility and independent action on the part of the employee, while most secondary jobs involve assignments that are more easily supervised (Katz 1986).

However, the presence of internal labour markets in the primary sector with internal promotions makes steeper tenure-earnings profiles or tournaments or even dismissal threats feasible and thus more attractive solutions than efficiency wages to agency problems.[16]

Moreover, casual observation suggests, according also to Katz (1986) that deferred compensation schemes and internal promotion ladders are observed in a large segment of the primary sector. In particular, these mechanisms appear in large establishments, where

[16] Dismissal threats can lead to the efficient outcome, provided that the firm pays the market clearing wage and that dismissal means banishment to the lower paying secondary sector or to another primary sector firm where the dismissed worker has to start from the lowest layer of hierarchy because an internal labour market implies that in the higher levels of hierarchy are assigned workers that have been longer with the particular firm.

monitoring problems are more likely to be important. Moreover, reputation concerns are likely to be important for the large visible employers such as IBM and general motors that provide high paying, primary sector jobs. Katz (1986) further suggests that these large firms offer exactly the type of jobs that the shirking model indicates. Smaller, less visible secondary firms which may not stay in business long are not likely to be able to get workers to trust that they will not renege on agreements concerning deferred compensation. The main result is that the limitations on bonding and other devices appear least important in exactly the type of jobs that some economists claim that should pay efficiency wages.

Thus, the implication of the above arguments is that, given that alternative devices are to be preferred to efficiency wages, as long as they are feasible, and provided that there are less considerations that limit alternative to efficiency wages devices in the primary than the secondary sector, efficiency wages are more likely to be the case in the secondary sector and thus in low-wage labour markets.

Perlman and Drago (1989) further suggest that the Bulow and Summers model is difficult to reconcile with the occurrence of important, non-dismissal based motivation schemes in primary sector firms and the apparent reliance upon monitoring and dismissal by many employers in secondary labour markets. Furthermore, there is little direct evidence that jobs in the primary sector are much more difficult to monitor than jobs in the secondary sector. Historical research indicates that monitoring employee performance and eliciting work effort is difficult and costly even in semi-skilled operative jobs (Clawson 1980, Lazonik 1983). Further many secondary jobs are in the service sector where supervision is often difficult (Rebitzer 1989).

Existing empirical evidence does not support the main assumption of Bulow and Summers that difficulties in monitoring lead to the payment of efficiency wages in primary sector jobs and market clearing wages in the secondary sector. In particular, Neal (1998) finds that differences in monitoring intensity and difficulty cannot explain inter-industry wage-differentials and in particular differences in pay between primary sector higher-wage and secondary sector lower-wage industries. Neal (1998) concludes that the evidence suggests that workers in primary sector jobs are supervised with equal or greater stringency than the secondary sector.

Moreover, limitations to bonding may be more severe in low-wage labour markets. In particular, liquidity constraints in bonding are more likely to be the case for lower wage workers. The concept that wages affect workers' productivity because of their effect on workers' caloric intake may be particularly relevant for developed economies but the efficiency wage type of argument that in general wages can affect workers living standards and physical well-being and in turns their morale and productive capacity seems to be more likely to hold for low-wage workers than higher-wage workers. The latter two arguments are supported by empirical evidence that low wage workers tend to be in low income households (Card and Krueger 1995, Dolado et. al 1996, Marx and Verbist 1998).

Even if the 'nutrition' efficiency wage argument is not that valid and even if monitoring is not a problem in the secondary low-wage sector, there may still exist adverse selection or even 'fairness' considerations that may lead to the payment of efficiency wages in low wage labour markets. Efficiency wages could be probably ruled out as a valid theory that can explain the operation of the secondary, low-wage sector if there is strong evidence that this sector clears and there is no involuntary unemployment, a hypothesis that is not supported by empirical evidence. In particular, Holzer, Katz and Krueger (1991) present evidence from a sample of low-wage firms, that suggests that employers pay rents in minimum wage jobs which can further explain the presence of job queues for these jobs. This evidence may provide support to efficiency wages, as may be viewed as evidence of involuntary unemployment in minimum wage jobs, and to the assumption of the turnover model that higher compensation (wages and nonpecuniary benefits) ease recruitment because it is a way to attract more applicants per vacancy. For example, a casual observation that suggests that low-wage sector employers face recruitment and turnover problems is presented by Card and Krueger (1995) who find that a significant proportion of low wage employers (in the fast food restaurant industry in particular) are paying bonuses to employees who help recruiting new workers.

There are other reasons why tournaments may be a less feasible solution for low-wage labour markets, which makes efficiency wages a more attractive motivation device. Tournaments can be a less feasible solution in the case that other firms offer straight-time contracts, where a deviating firm offering a tournament may not be able to attract any employed workers (Milgrom and Roberts 1992). In the extreme case where there is no upper bound on the ability distribution of workers, each worker might think that only more able workers will join the firm offering the tournament and hence would think that the expected wage for workers of his/her own type would be the wage associated with finishing last in the tournament (Weiss 1990). Even if workers do not have these pessimistic beliefs, uncertainty concerning which workers will apply to the tournament firm would deter applications from risk averse workers (Ritter and Taylor 1997). Consequently, as low wage workers are more likely to be low-ability types that are not expected to have high expectations as far as their chances to be ranked first in the tournament, firms would not offer tournament wage schedules in low wage labour markets.

Furthermore, there are arguments that may suggest that any incentive effect of higher wages is stronger for low-wage than high-wage employees. This may be the case because any income effect of the wage, that weakens motivation and incentives, is more likely to be stronger for high-wage workers, a hypothesis that is supported by empirical evidence in the case of labour supply decision (Killingsworth 1983) which can be viewed as very similar to the decision of effort supply or quitting by employees.

Additionally, as job impermanency and high quit rates are pervasive features of low-wage labour markets, as suggested by Manning (2003) the optimal type of contract for low-wage workers who have a higher propensity to quit is a flat tenure-earnings profile, which is another argument that the features of low wage labour markets severely constrain bonding, and thus under weak incentives efficiency wages should be preferred.

Another limitation to bonding is that institutional constraints that are particularly binding in low-wage labour markets as minimum wages may further limit firms in offering steep seniority wage schedules. Also, in the case that steep tenure-earnings profiles are in place, if a minimum wage is imposed and, provided that wages of more senior workers are not affected, then the seniority-wage schedule tilts clockwise and becomes flatter and thus may weaken the incentives provided.[17] This latter argument suggests that the presence of

[17] The available evidence suggests that training is not reduced as a response to the minimum wage and that is why flatter tenure-earnings are not the result of reductions in training offered in junior employees (Brown

valid limitations to bonding in low-wage labour markets, makes efficiency wages contracts more likely for these markets but also provides an explicit link between efficiency and minimum wages.

There is more evidence from the minimum wage literature that provides further support to the relationship between efficiency wage theory, low-wage labour markets and the minimum wage. As discussed in one of the previous sections except of the recent striking evidence of a non-negative effect of minimum wage introduction/increase on employment, other stylized facts of the minimum wage literature that are consistent with efficiency wage theory is the non-utilisation of subminimum wage provisions by employers and the fact that the evidence suggests that employers do not cut fringe benefits as a response to the minimum wage. The latter is supported by the evidence presented by Holzer, Katz and Krueger (1991) discussed also above. Finally, the evidence of limited spill-over of minimum wage increases to workers just above the minimum wage may be explained in terms of perceived equity and fairness considerations that are consistent with the gift-exchange efficiency wage model.

One of the major reasons why we focus in the topic of minimum wages in order to show the relevance of efficiency wages for low-wage labour markets, is that the minimum wage provides a unique setting to test the validity of efficiency wages theory as one can test whether the benefits for employers of an above market clearing wage more that offset the associated costs. The only problem with this latter test is that the wage increase above the market clearing wage generated by the imposition of a binding minimum wage is exoge-

1999).

nous in contrast to the efficiency wage theory assumption that wages are set optimally by employers. However, this test could be extremely informative of how low-wage employers behave and thus also how low-wage labour markets operate, as findings may indicate whether low-wage employers operate at peak efficiency as the neoclassical model predicts.

The above analysis briefly presents the main theoretical arguments and evidence that support an efficiency wages view of low-wage labour markets. It is widely accepted that in general, evidence on efficiency wages does not seem so persuasive and that is why more credible attempts and more robust evidence is needed to support the efficiency wage story. All the above analysis does is to emphasise that at least one cannot rule out the hypothesis that efficiency wages could provide valuable insight into the operations of low-wage labour market and to highlight the main motivation for this thesis.

1.6 Focus of the Thesis

The analysis in this chapter highlights the main weaknesses and limitations of the neoclassical-competitive view of labour markets and thus the inability of the simple textbook model to explain observed findings from low-wage labour markets, as particularly suggested by the main empirical evidence from the minimum wage literature. The incompleteness of the competitive framework gives rise to the development of alternative theories that could better reconcile with the main features and observed phenomena in low-wage labour markets. We present the main theoretical arguments and empirical evidence that support the view that the nature and operation of low-wage labour markets impose considerable constraints to the feasibility of optimal (first-best) labour contracts, and that is why efficiency wages may arise naturally as a second best contract. More observations and evidence from low-wage labour markets and in particular from the minimum wage literature seems also to reconcile with many of the main features of efficiency wage theory.

The above discussion summarises the motivation of the thesis which has as main objective to investigate whether the efficiency wage theory is valid in low-wage labour markets and also in particular whether efficiency wages could provide valuable insight into the economic effects of the minimum wage. The thesis addresses the hypotheses of interests in the following way: Based on the premise that there are valid efficiency wages considerations in low wage labour markets, we start by extending the seminal efficiency wage shirking model of Shapiro and Stiglitz (1984) used by Rebitzer and Taylor (1995) to predict the economic effects of the minimum wage. The extended model relaxes a simplistic and unrealistic assumption of the model of Rebitzer and Taylor, and shows that the prediction that a higher minimum wage may increase employment does not hold, once the assumption of fixed supervision is relaxed. Moreover, we show how our extended version of the shirking model can generate more robust and accurate predictions that also seem to reconcile with recent empirical evidence of the minimum wage literature. Furthermore, based on the fact that efficiency wages cannot be dismissed based on solely theoretical arguments and that existing evidence on efficiency wages is weak, we empirically test the validity of efficiency wages for unskilled, low-wage workers compared to skilled, high-wage workers using data on establishments from almost all sectors of the UK industry. The empirical investigation also attempts to address the main empirical problems that hinder empirical studies of efficiency wages and have been the main reasons why the evidence produced up to now seems unpersuasive (Manning and Thomas 1997, Manning 2003). We also empirically investigate the effects of the recent UK National Minimum Wage (NMW) 1999 introduction and 2001 increase on the main economic outcomes in a very low-wage UK sector and test whether the empirical evidence produced support the efficiency wage theory or other main theoretical models used in the analysis of the economic effects of the minimum wage. Finally, the NMW introduction and increase enables us to explicitly implement an empirical test of efficiency wages using data from a low-wage sector and thus investigate the validity of the hypothesis that efficiency wages can provide valuable insight in the operation of low-wage labour markets.

Chapter 2
The Consequences of Minimum Wage Laws:Some Theoretical Ideas Revisited

2.1 Introduction

The minimum wage has been always the subject of considerable controversy among economists, policy makers and the general public. Economic literature in the topic of minimum wages has been mainly focused on the effects the minimum wage has on employment and the wage distribution.

The effects of minimum wages on the wage distribution became quite clear recently as most of the available evidence suggests that the minimum wage seems to reduce wage inequality (Dinardo, Fortin and Lemieux 1996, Dickens, Machin and Manning 1999, Brown 1999).[18]

Moreover, the relative consensus (Brown Gilroy and Kohen 1982, Brown 1988) that increases in the minimum wage decrease the employment of affected workers was challenged in the early 1990s by findings that supported a non-negative minimum wage employment effect (Card 1992a, Card 1992b, Katz and Krueger 1992, Card and Krueger 1994, Card and Krueger 1995), which also led to a renewed interest in the topic. Recent studies either report negative but small estimates of minimum wage elasticity (Neumark and

[18] However, the ability of the minimum wage to equalize the income distribution seems to be quite limited (Brown 1999) and thus it is not very clear whether the minimum wage should be preferred to other transfer programs, which is in turn an outcome determined by many factors (Dolado et al. 1996, Dolado et al. 2000).

Wascher 1999) and stick to the earlier literature which suggests that the evidence support the prediction of the competitive model or fail to find any employment effect of the minimum wage at all (Dolado et al. 1996, Machin and Manning 1994, Dickens Machin and Manning 1999) a result that seems to cast doubt on the validity of the competitive model.

One of the main reasons why the debate in the topic of minimum wages has concentrated on the employment effects of the policy is that although the main stylized facts of the minimum wage literature could be possibly explained (not all together though) by some variant of the competitive model, no version of the competitive model can reconcile with a non-negative (long-run) employment effect of a minimum wage increase (Card and Krueger 1995). This latter argument indicates the link between the employment effects of the minimum wage and the validity of the competitive model of the labour market.

The new evidence hasn't gone unchallenged (Kennan 1995, Neumark and Wascher 1996a, Neumark and Wascher 1996b) as it seemed to reverse what has been thought as similar to the law of gravity (Dolado et al. 2000, Manning 2003). Although the critics have concentrated on the methodology, another central issue has been the theoretical explanation of the non-negative minimum wage employment elasticity.[19] The standard theoretical case under which a suitably set minimum wage may not necessarily decrease employment includes the static monopsony model (Robinson 1933, Charles 1974) that is presented in most introductory labour economics textbooks. However, the static monopsony model has been dismissed as merely intellectual curiosity that cannot be the rule in low-wage labour markets, where the minimum wage 'bites'(Dolado et al. 1996).

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[19] As Paul Samuelson has suggested: "In Economics it takes a theory to kill a theory; facts can only dent a theorists hide" (Card and Krueger 1995).

Although, etymologically the term monopsony means the presence of a single buyer in the market, it is often used to denote all situations where employers have some discretion in setting wages (Card and Krueger 1995, Manning 2003). Recent, influential work by Manning (2003) is based on the premise that the presence of labour market frictions conveys wage-setting, monopsony power to employers. Manning presents an array of theoretical arguments, observations and empirical evidence that support the fact that monopsony and not perfect competition seems to be the rule in labour markets. Therefore any theoretical model where employers have wage-setting power (because of labour market frictions) can also generate the monopsony prediction that an increase in the minimum wage may have a zero or positive effect on the employment of affected workers.

Theoretical models of frictions include oligopsony and monopsonistic competition models (Demsetz 1973, Bhaskar and To 1999, Bhaskar, To and Manning 2002) where frictions arise either because firms differ discretely along dimensions, like location or working conditions and workers have heterogeneous preferences over those dimensions or if workers must incur costs (whether pecuniary or psychic) to change firms (Ioannides and Pissarides 1985). Another category of models of frictions and wage-setting power are equilibrium search models (Lang and Dickens 1993, Manning 1993, Burdett and Mortensen 1998) where frictions arise because workers have imperfect information about alternative possible job opportunities and that is why there are job search costs.

Another situation where employers have wage-setting power (that may not be necessarily the result of labour market frictions) is the case of efficiency wage models (Calvo and Wellisz 1979, Rebitzer 1995, Manning 1995). In these models, employers have imperfect information about worker's actions and productive characteristics and because of restrictions in the contracts they can offer, they motivate, recruit and retain workforce by paying wages that are above the workers' outside option. Provided that the wage is also a personnel policy device that contributes to higher worker's productivity, a suitably set minimum wage is possible to increase or have no effect on employment of low-wage workers (Manning 1995).

There are several theoretical arguments and observations that support the fact that agency and adverse selection problems are present in low-wage labour market, where because of binding constraints the optimal contract may be to pay a single wage above the worker's outside option (see chapter 1 for details). There is also empirical evidence from low-wage labour markets that provide support to the efficiency wage story. In particular, Holzer, Katz and Krueger (1991) find evidence of queues in minimum wage jobs that further suggest that employers do not completely offset the costs of the increase in the minimum wage by reducing nonpecuniary benefits and thus there exist rents in these jobs.

Moreover, Krueger (1991) presents evidence from the fast-food industry (the quintessential employer of minimum wage workers in the US) that company-owned establishments on average pay higher wages than franchisee-owned establishments, as in the former monitoring is inferior because managers have less of an incentive to closely supervise employees. This finding supports the efficiency wage models prediction,[20] that in equilibrium there is wage-supervision trade-off. Therefore both studies present evidence that explicitly associate minimum and efficiency wages.

[20] The wage-supervision trade-off is a prediction generated by both the shirking (Shapiro and Stiglitz 1984) and the gift-exchange (Akerloff 1982) models of efficiency wages (see Rebitzer, 1995 for details).

The above discussion may justify why efficiency wage models have been used to analyse the economic effects of minimum wages. As mentioned also above the main efficiency wage models (Calvo and Wellisz 1979, Rebitzer and Taylor 1995, Manning 1995) of the minimum wage literature have been mainly developed in order to provide an explanation of the recent findings of a positive employment effect of a higher minimum wage. However, the fundamental prediction of these models seems to hinge critically on simplified assumptions and even more crucially, except of the prediction of the minimum wage on employment, the ability of these models to reconcile with the main stylized facts from the minimum wage literature is rather limited (Card and Krueger 1995). Finally, Card and Krueger (1995) point out that additional research should focus on a rigorous evaluation of the alternative theoretical models that have been used to explain the stylized facts that fail to reconcile with the standard competitive model.

In this chapter, we extend the efficiency wages-shirking model of Shapiro and Stiglitz (1984) used by Rebitzer and Taylor (1995) to predict the employment effects of the minimum wage, in order to take into account that supervision and thus monitoring intensity is determined optimally by firm's decisions. We show that the simplified assumption of fixed supervisory resources is critical for the production of the prediction that an introduction/increase in the minimum wage may increase employment of covered workers, as this result is no longer robust to the relaxation of this assumption.

We also show that, in the seminal model presented by Calvo and Wellisz (1979), the assumption of constant returns to scale in efficient labour input is critical for their result that up to a point an increase in the minimum wage increases the employment of workers and decreases that of supervisors, and that their main prediction that the increase in the minimum wage will unambiguously increase the employment of covered workers cannot be sustained if this assumption is relaxed.

Therefore, the main contribution of this chapter is that we show that the fundamental prediction that a minimum wage may increase employment generated by two of the seminal theoretical models deployed to analyse the economic effects of the minimum wage under an efficiency wage framework, hinge on simplified and ad hoc assumptions and are not robust to the change of these assumptions.

Our analysis also suggests that under a shirking model with endogenous determination of supervision the employment effect of a binding minimum wage can be decomposed into two distinct effects; The 'direct' wage effect and the 'supervision' effect of the wage which are counteractive, and this is why our theoretical framework can more accurately explain the recent very important empirical evidence that show that the minimum wage may have a small negative or zero employment effect on employment (Card and Krueger 1995, Brown 1999, Dolado et al. 2000), than the model of Rebitzer and Taylor.

We also show how our extended theoretical framework can be used to explain the striking empirical findings from the fast food studies of Katz and Krueger (1992) and Card and Krueger (1994), that have renewed the interest in the topic of minimum wages, where employment increased in low-wage, more affected restaurants compared to high-wage, less affected restaurants, after the minimum wage increase.

2.2 Efficiency Wage Models of the Minimum Wage

In the previous section, it has been suggested that there are many different theoretical approaches that have been deployed in the minimum wage literature in order to explain the evidence of a positive or zero employment effect of the minimum wage. One of these approaches is based on the premise that employers pay efficiency wages because of asymmetric information and shirking considerations on the job.

In particular, Rebitzer and Taylor (1995) develop a model based on the standard shirking model of Shapiro and Stiglitz (1984) which predicts a positive effect of a minimum wage on employment, even when the number of firms in the industry is large. This model has been cited in all reviews in the topic of the minimum wage (Card and Krueger 1995, Brown 1999) as one of the alternative theoretical explanations of the increasing employment effect of a higher minimum wage.

Furthermore, a model that it seems curiously neglected in the literature is presented by Calvo and Wellisz (1979). Calvo and Wellisz examined labour allocation and wage scale, for a competitive hierarchic firm, in a more general environment, than those presented by Rebitzer and Taylor. Under the hierarchic framework of Calvo and Wellisz the main prediction is that a binding minimum wage increases the quantity and quality of covered workers and decreases the quantity, quality and the wage of supervisors.

Finally, Manning (1995) presents an attempt to illustrate that many labour market phenomena are consistent with the presence of monopsony, as for example involuntary unemployment arising from minimum and efficiency wage floors. Manning presented a combined monopsony-shirking model,[21] where workers differ in their valuation of leisure and firm has ex ante ability to identify workers who are more likely to shirk and concludes that under this environment an increase in the minimum wage will increase employment and may also decrease unemployment.

However, existing seminal models seem to have some limitations and we believe that some of their results are driven by some of their specific assumptions that may not capture some of the true features of the low-wage labour market.

Although, Rebitzer and Taylor assume that supervisory resources are assumed to be exogenous,[22] empirical studies of efficiency wages (Leonard 1987, Groshen and Krueger 1990, Rebitzer 1995) that test the efficiency wage prediction of the wage-supervision trade-off suggest that endogeneity is a standard problem of all studies that estimate wage equations and include supervision proxies among the explanatory variables, as supervision is a choice of the firm.[23]

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[21] One can view Manning's combination of monopsony and efficiency wages model, as similar to Rebitzer and Taylor's model where monopsony arises because of imperfect observability of effort and a fixed capacity to supervise employees which is the reason why employers pay efficiency wages. Because supervision is fixed the probability of detection is a decreasing function of the number of employees. Under this framework an upward sloping wage-employment setting relationship arises because an extra employee will decrease the probability of detection and increase the propensity of workforce to shirk and that is why the wage should be increased in order to prevent employees from shirking. The main difference between Manning's and Rebitzer and Taylors framework is that in the former employees differ in their innate propensity to shirk, whereas in the latter employees are homogeneous. However, we argue that the two environments can be equivalent as Manning suggests that employers have some ex ante ability to screen employees who are more likely to shirk, which further implies that the recruited employees will be quite similar because they will exhibit a relative minimum propensity to shirk. Screening doesn't imply elimination of shirking as employed workers may again shirk and thus a high wage and supervision can be used to prevent shirking.

[22] The model of Rebitzer and Taylor (1995) is a special case of the model presented by Calvo and Wellisz (1979), who also show that under a shirking model with homogeneous workers and fixed supervision a minimum wage increases employment of covered workers. The fact that the Rebitzer and Taylors result has been previously produced by Calvo and Wellisz (1979) seems to be neglected in the literature.

[23] We know only of rare exceptions in which supervision intensity is exogenously determined. For example in the US hospital industry the supervisor to staff ratio is often regulated by the state or federal government (Groshen and Krueger 1990). Moreover, in some other industries, as the petrochemical industry (Rebitzer 1995), safety regulations may impose a fixed supervisor to staff ratio for some occupations.

Furthermore, as Rebitzer (1995) argues efficiency wage models apply only where employee actions or characteristics are difficult to observe, fact which contradicts Manning's assumption that employers have some ability to observe workers' inclination to shirk. In general we would expect that several of workers' characteristics as for example their reservation wages or their innate inclination to shirk to be their private information.[24]

Finally, in Calvo and Wellisz (1979), it can be shown (see following sections) that their main predictions of the positive employment effect of an increase in the minimum wage, hinge on assumptions that aim in generating desirable properties of their hierarchic structure of the firm which in turn are critical for the rest of their results on labor allocation and wage scale.

2.3 The Worker

In this and the next section, we present an extension of the version of the shirking model of Shapiro and Stiglitz (1995) used by Rebitzer and Taylor (1995) to predict the employment effects of the minimum wage, by relaxing the Rebitzer and Taylor assumption that supervisory resources are fixed.

Consider a competitive industry, with a large number of identical firms, where the representative firm recruits a number of low-skilled, low-wage workers to produce a single product. Workers are homogeneous, infinitely lived and risk neutral with instantaneous

[24] Manning's assumption is made for the shake of simplicity in order to illustrate his main theoretical point that involuntary unemployment is not inconsistent with the presence of monopsony in the labour market. As discussed previously Manning's model can be seen as Rebitzer and Taylors model with heterogeneous workers, where the heterogeneity characteristic is imperfectly observed by the employer and fixed supervisory resources.

utility function given by:

$$U(w, e) = w - e \quad (1)$$

Hiring takes place at the beginning of the year, and thus after a worker is hired, and for a given wage offer, she must decide whether she will work or shirk. If the worker shirks then she contributes zero effort and if she works then she contributes a positive level of effort which for simplicity we will assume it is equal to one, i.e. $e \in \{0, 1\}$.

The employer cannot perfectly observe employees' effort, even though he employs supervisors who monitor workers and try to detect shirkers. We will assume that dismissal threats,[25] is the only device available to employers to prevent shirking and thus there is no other way to solve the problem of asymmetric information.[26]

On the other hand supervisors are employed from a pool, of homogeneous, non-shirking workers, and their wage is given and independent of the wage of workers.[27] The instantaneous probability of detection of a shirker is given by:

$$P = Min\{\frac{N}{L}, 1\} \quad (2)$$

[25] In partial equilibrium, monitoring technology is used in order that dismissal threats are not empty. The penalty of dismissal is the loss of the wage premium.

[26] An alternative way that is suggested in the literature is bonding which may be limited because of capital markets constraints and moral hazard problems on the side of employer (Weiss 1990). Moreover, the presence of a binding minimum wage may also limit employers from implementing steeper tenure-wage profiles as a solution to agency problems.

[27] Calvo and Wellisz (1979) present a theoretical model of a hierarchic organisation where production workers are supervised by employees at the immediately higher layer of hierarchy, who in turn are supervised by the employees of the layer just above and so forth up to the highest layer of hierarchy. The implicit assumption made is that the owner-manager or employees at the highest layer of hierarchy are self-monitored because they are the residual claimants of the firm's surplus. As suggested by the discussion of chapter 1, bonding or other efficient (first-best) contracts may be less limited for higher wages workers. For example an implication of a binding minimum wage in the labour market is that employers can use steeper-tenure profiles to motivate higher wage workers but cannot use bonding for low-wage workers, because of the binding minimum wage and that is why they pay efficiency wages to those workers. This is why higher-wage workers in our model, who supervise production workers do not shirk and they are paid their outside option, whereas low-wage workers who are those affected by a minimum wage may shirk and that is why they are paid an efficiency wage.

, where N and L is the quantity of employed supervisors and workers respectively.[28] We will assume that 1 in equation (2) is never binding.[29] Furthermore, detection is taking place at the beginning of each period and workers who are caught shirking flow to unemployment and receive an unemployment benefit μ. The instantaneous probability that a worker will be separated from his or her job due to exogenous reasons is q. Let r represent the discount rate and s to be the exogenous probability that an unemployed worker will find a job.

The present discounted value (p.d.v) of expected lifetime utility of a worker, when she is not shirking, V^w can then be written as:

$$V^w = w - e + \frac{(1-q)V^w + qV^u}{(1+r)} \quad (3)$$

where V^u is the p.d.v of expected lifetime utility of an unemployed worker. Similarly, the p.d.v of expected lifetime utility of a shirker $V^s$is given by:

$$V^s = w + \frac{(1-P)(1-q)V^s + [1-(1-P)(1-q)]V^u}{(1+r)} \quad (4)$$

Finally, the p.d.v of expected lifetime utility of an unemployed worker V^u, is given by the following equation:

$$V^u = \mu + \frac{sV^w + (1-s)V^u}{(1+r)} \quad (5)$$

[28] The choice of this probability of detection seems reasonable under the assumption that supervision is based on labour services, but it can be also used in the case where supervision is based on capital services denoting the capital per supervisee ratio. As it is suggested by Odiorne (1963) the supervisory resources-to-staff ratio is likely to be highly correlated with the extent of employee monitoring. In our case the probability of detection and the degree of monitoring intensity are tautosimous.

[29] This assumption holds as long as the cost of supervision increases sufficiently fast with the quantity of supervisors. If one in equation (1) was binding then the model specializes to the standard one in the theory of the firm.

We are assuming that once a worker chooses to shirk he will always shirk and the same holds if she chooses to work. Moreover, if an unemployed worker finds a job she will work rather than shirk. A worker will shirk unless the p.d.v of expected lifetime utility of being a shirker is less than or equal to that of being a worker. This is expressed by the following equation:

$$V^w \geq V^s \text{ (6)}$$

Combining (3), (4), (5) and (6) we obtain the following equation:

$$w \geq \mu + e + \frac{e(r+s+q)}{P(1-q)} \text{ (7)}$$

Equation (7) is known as the non-shirking condition (NSC) (Shapiro and Stiglitz 1984), and expresses the set of all wages that prevent shirking for any given level of e, μ, r, s, q and P. The firm will be willing to pay the lowest possible wage associated with non-shirking. It is intuitive that the non-shirking wage w will be higher, the higher the unemployment benefit μ, the interest rate r, the rehiring rate s, the quit rate q, and the lower the probability of detection P. Using equation (2), (7) and the fact that the NSC holds with equality we obtain equation (8):

$$w^* = \mu + e + \frac{e(r+s+q)}{\frac{N}{L}(1-q)} \text{ (8)}$$

, where w^* is the optimal non-shirking wage. The main difference of equation (8) compared to the standard shirking model of Shapiro and Stiglitz (1984) is that the probability of detection is a function of the ratio of the number of supervisors to the number of production employees and thus it is endogenous to the firm, whereas in the Shapiro and Stiglitz model the probability of detection is assumed to follow a poisson process and thus it is exogenous.

Moreover, in the Rebitzer and Taylor model the probability of detection is assumed to be a only a decreasing function of the number of production employees, and supervisory resources are treated as fixed (exogenous) to the firm.

Finally, as in the standard shirking model it is rather intuitive that the non-shirking wage w^* will be higher, the higher the unemployment benefit μ, the interest rate r, the rehiring rate s, the quit rate q, and the lower the probability of detection $\frac{N}{L}$.

2.4 The Firm

The employers decision problem is to choose the optimal combination of the wage, employment and supervision in order to maximize profits subject to the non-shirking condition. Based in the analysis of the previous section and using also equation (8) the effort of the typical worker can be expressed as a function of the wage w, the level of employment L and the level of supervision N, as follows:

$$e(w,L,N) = \left\{ \begin{array}{l} 1, \text{if } w \geq w^*(N,L) \\ 0, \text{if } w < w^*(N,L) \end{array} \right\} (9)$$

Equation (9) suggests the fact that employees will work if the offered wage is above the non-shirking wage, where the level of the non-shirking wage depends on the number of supervisors per employee in the firm. By equation (9) and the fact that the level of output depends on efficient labour input we obtain the following equation of the production function:

$$f[e(w,L,N)L] = \left\{ \begin{array}{ll} f(L), \text{if } w \geq w^{*}(N,L) \\ 0, \quad \text{if } w < w^{*}(N,L) \end{array} \right\} (10)$$

,where (10) assumes that $f(0) = 0$ and we will also assume that the production function exhibits diminishing marginal productivity in the efficient labour input ($f' > 0$, $f'' < 0$). One can easily show that, under the latter conditions the production function also exhibits decreasing returns to scale in the efficient labour input (see section 1 of the appendix for proof). The production function expressed by (10), is not continuous with respect to the wage, which is also the case in the model of Rebitzer and Taylor.

In particular, Rebitzer and Taylor suggest that because the production function is not continuous with respect to the wage the profit function will not also be continuous and thus one cannot differentiate the profit function with respect to the wage in order to determine the maximum.

The typical firm's profit maximization decision can be written as:

$$\max_{w,L,N} \Pi(w,L,N) = \max_{w,L,N} f[e(w,L,N)L) - wL - cN \ (10)$$

$$s.t\ w = \mu + e + \frac{e(r+s+q)}{\frac{N}{L}(1-q)} (11)$$

, where the product price has been normalized to one and thus the production function is equivalent to the revenue function and c stands for the exogenously given price of supervisory resources. Based on fundamental results of real analysis (Protter and Morrey 2000), the production function $f(w,L,N)$, is continuous at the constraint set Γ[30] and piecewise

[30] A function f on $\Re^n$is said to be continuous relative to a subset S of $\Re^n$if the restriction of f to S is a continuous function. Continuity relative to S means, in other words, that, for $x \in S$, $f(y)$ has to approach

continuously differentiable (see figure 1.1)[31] at Γ and thus the same holds for the profit function, at Γ, where Γ is given by

$$\Gamma = \{(w, L, N) : w \geq \mu + e + \frac{e(r+s+q)}{\frac{N}{L}(1-q)}, L \in (0, +\infty), N \in (0, +\infty)\} \quad (12)$$

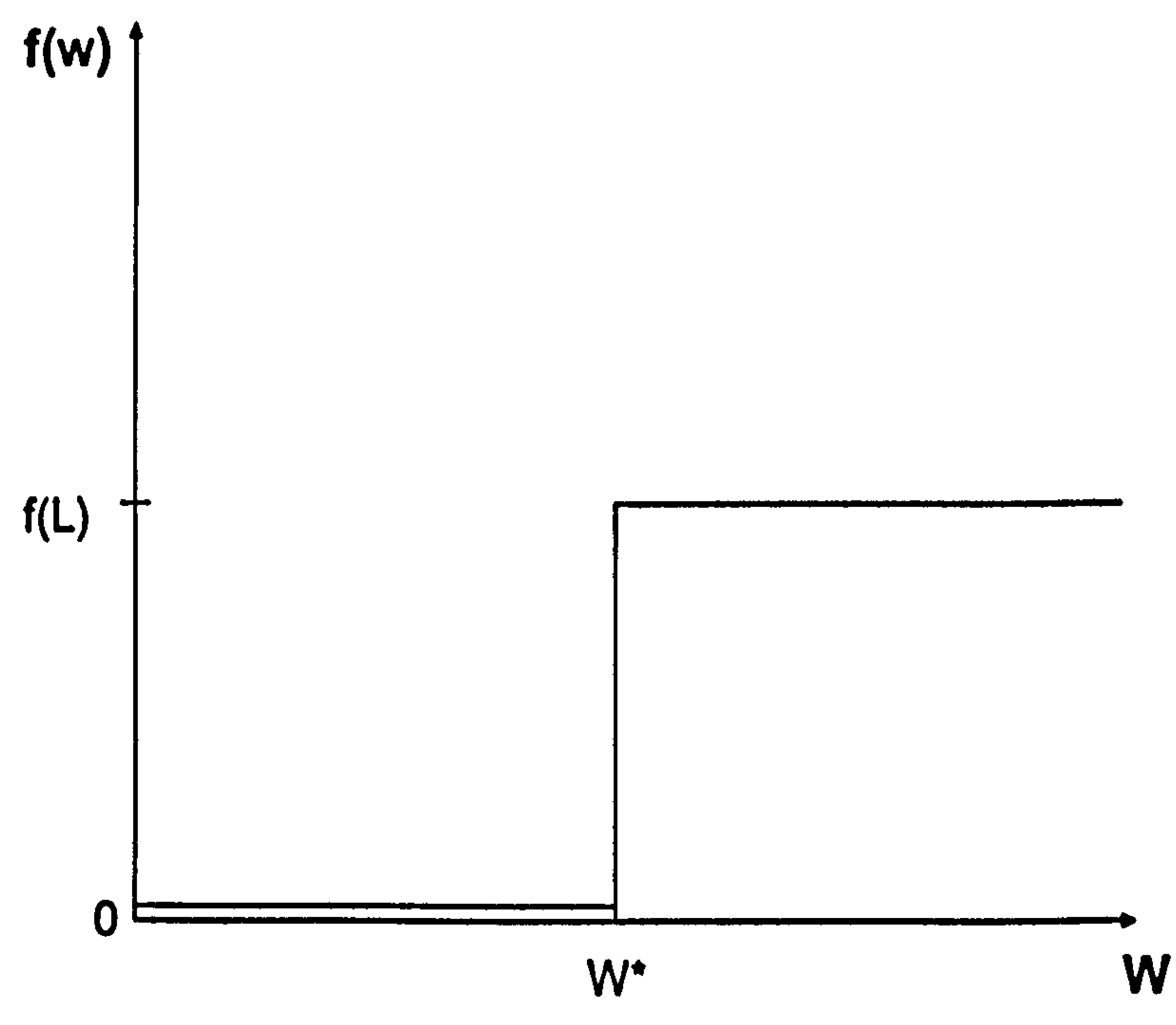

Figure 2.1: The piecewise continuously differentiable production function

Equation (11) can be used to express supervisory resources as a function of employment and the wage:

$$N(w, L) = \frac{Le\,(r+s+q)}{(1-q)\,(w-\mu-e))} \quad (13)$$

$f(x)$ as y approaches x along S, but not necessarily as y approaches x from the outside of S (Rudin 1976).

31 A piecewise continuously differentiable function is a function that almost everywhere the derivative exists and at points where the derivative does not exist left hand-side and right hand-side derivatives exist (Rudin 1976, Protter and Morrey 2000).

with $N_w < 0$, $N_L > 0$, $N_{ww} > 0$ and $N_{Lw} < 0$. These results are generated because of the standard prediction of the shirking model that there is a trade-off between the wage and monitoring intensity. This means that an increase in the wage, decreases the propensity to shirk, and for given effort, monitoring intensity can be relaxed. For given employment, monitoring intensity is relaxed by a fall in supervision. Similarly, an increase in employment, given everything else, decreases the probability of detection, and for given wage, supervision must be increased to keep motivation at the same level. If we substitute (13) into (10), and use also the fact that effort is one for all wages above the non-shirking wage then the maximization problem becomes:

$$\max_{w,L} \Pi(w, L) = \max_{w,L} f(L) - wL - cN(w, L) \; (14)$$

The first order conditions for profit maximization are given by the following equations:

$$\Pi_L = 0 \Rightarrow f_L = w + cN_L \; = 0 \; (15)$$

$$\Pi_w = 0 \Rightarrow -\frac{cN_w}{L} = 1 \; (16)$$

Equation (15) expresses the fact that in equilibrium the marginal revenue product is equal to the marginal cost of labour which in this case exceeds the wage. The marginal cost of labour has two components, the wage and the marginal monitoring cost of employment, which is decreasing in the wage. The fact that the marginal revenue product of labour exceeds the wage suggests that the firm has some monopsony power, arising from the upward sloping relationship between the wage and employment from the non-shirking condition.

Equation (16) denotes the standard Solow condition: the wage is chosen to minimize the average cost of labour. This is because a higher wage has as a result to increase average labour cost but on the other hand it also decreases average labour cost as it decreases the average monitoring cost, because of the wage-supervision trade-off. In equilibrium the wage increase is exactly offset by the decrease in the average monitoring cost of labour. The change in employment after the introduction of a binding minimum wage is given if we totally differentiate equation (15):

$$\frac{dL}{dw} = -\frac{\Pi_{Lw}}{\Pi_{LL}} \quad (17)$$

,where Π_{LL} is the own second order partial derivative of the profit function w.r.t employment, and Π_{Lw} is the cross partial derivative of the profit function. Therefore, provided that the second order conditions of profit maximisation hold we have:

$$sign(\frac{dL}{dw}) = sign(\Pi_{Lw}) \quad (18)$$

Where Π_{Lw} is given by:

$$\Pi_{Lw} = -1 - cN_{wL} \quad (19)$$

, by (16) and the fact that $cN_{Lw} = \frac{cN_w}{L}$, we obtain that employment does not change, after the imposition of a just binding minimum wage ($\Pi_{Lw} = 0$). This implies that the profit maximizing wage is the employment maximizing wage.[32]

Alternatively, a higher wage does not affect the marginal revenue product of labour but only the marginal cost of labour. In particular, the wage increase, on the one hand increases the marginal cost of labour but on the other hand it decreases the marginal monitoring cost of labour, as it increases motivation and thus monitoring intensity can be relaxed.

[32] It has been shown that, $\frac{dL}{dw}|_{w=\tilde{w}} = 0$, where $\tilde{w}$ is the profit maximising wage. Using the same procedure, we have that: for $w > \tilde{w}$, $\Pi_{Lw} < 0 \Rightarrow \frac{dL}{dw}|_{w>\tilde{w}} < 0$, and for $w < \tilde{w}$, $\Pi_{Lw} > 0 \Rightarrow \frac{dL}{dw}|_{w<\tilde{w}} > 0$. Suggesting that $\tilde{w}$ is the employment maximizing wage, in this case.

Thus, when a minimum wage is introduced/increased marginally above the equilibrium (efficiency wage),[33] the increase in wage costs is exactly offset by a decrease in the marginal monitoring cost and the introduction/increase of the minimum wage has no effect on employment.[34] However, as it is easily deduced by (16), (18) and (19) any non-infinitesimal increase in the wage because a the introduction/increase of a minimum wage, will decrease employment.

Thus under the shirking model's version, where workers are homogeneous and supervisory resources are endogeneously determined, employment cannot increase as a result of the minimum wage introduction/increase.[35]

This further suggests, that Rebitzer and Taylor's (1995) widely cited result, that a binding minimum wage increases the employment of covered workers, when workers are

[33] The prediction holds for the case where a minimum wage is introduced just above the equilibrium wage, in a previously unregulated labour market, and for the case where there is a non-binding minimum wage in the labour market (because price increases may erode the real value of the minimum wage) that is then increased just above the equilibrium wage.

[34] In general, the optimal employment decision of the firm is given by an equation of the form: $\Pi_L = R_L - C_L = 0$, where R_L stands for the marginal revenue product of labour and C_L stands for the marginal cost of labour. Moreover, we have shown that the change in employment is given by equation (19), with $sign\Pi_{Lw} = sign(R_{Lw} - C_{Lw}) =$
$= sign(R_{Lw}\frac{w}{R_L} - C_{Lw}\frac{w}{C_L}) = sign(E_w^R - E_w^C)$, the change in employment depends on whether or not in equilibrium the elasticity of the marginal revenue product of labour w.r.t the wage (E_w^R) exceeds the elasticity of the marginal cost of labour w.r.t the wage (E_w^C). This is general condition under which employment will increase as a result of an exogenous wage increase, in an efficiency wages environment, where the wage affects both revenue and costs. A similar condition is presented by Manning (1995).

[35] Since we operate on the employment maximizing wage, the first order effect of an infinitesimal increase in the wage above the profit maximizing wage is zero but there is a negative second order effect. Similarly as suggested above, any non-infinitesimal increase in the wage will have a first-order negative employment effect. Therefore, one could also argue that the increase in the wage when supervisory resources are endogenous has as a result a fall in employment.

homogeneous, hinges heavily on their assumption of fixed supervisory resources,[36] and cannot be sustained in the case where supervision is not fixed.[37]

This finding is important, as in the real world, except of few cases where supervision is exogenously regulated by government or other institutions, the employment of supervisory resources is a choice of the firm (Rebitzer 1995).

Furthermore, profits fall because the minimum wage increases the average cost of labour, as the increase in the wage is less than offset by the fall in the average monitoring cost of labour, as it can be understood by (16).[38] Moreover, it can be shown that supervisory resources fall for a just binding minimum wage. In particular, the effect of an exogenously set higher wage on supervision is calculated using (13) and is given by:

$$\frac{dN}{dw} = \frac{\partial N}{\partial w} + \frac{\partial N}{\partial L}\frac{dL}{dw} \quad (20)$$

Under homogeneous workers, and binary effort and as it is also suggested by (13) the standard efficiency wages predictions hold, i.e. there is a trade-off between supervision

[36] This is very intuitive, as an increase in the wage, under Rebitzer and Taylors environment, will increase employment, because supervision intensity must be relaxed, due to the standard wage-supervision trade-off relationship of the shirking model. When supervision is fixed, the probability of detection is decreased by increasing employment. If supervisory resources are endogenous, monitoring intensity can be relaxed after the wage increase by also decreasing the number of supervisors. Thus, there are two counteracting effects of the wage on employment, the wage effect for given supervision, namely the 'direct' wage effect and the 'supervision' effect of the wage.

[37] Additionally, the intuition that Rebitzer and Taylor provided to justify their positive employment effect of an increase in the minimum wage is not that valid under their assumption of fixed supervision, as they suggest that an increase in the wage decreases the propensity to shirk which enables the firm to free up some resources from supervision and devote them to employment, because the firm is initially supply constrained, because of the upward sloping marginal cost of labour curve. This intuition, strictly speaking is not consistent with their story, as supervisory resources are fixed under the Rebitzer and Taylor model. Lin (1999), also showed that Rebitzer and Taylors result is not also the case if only their assumption of homogeneous workers is relaxed.

[38] Strictly speaking, as in the case of employment a just binding minimum wage will have a negative second order effect on profits, whereas the minimum wage introduction/increase will have a negative first order effect on profits, if the minimum wage is set well above the efficiency wage.

and the wage ($\frac{\partial N}{\partial w} < 0$), supervision is increasing in employment, ceteris paribus ($\frac{\partial N}{\partial L} > 0$) and employment is increasing in the wage increases, ($\frac{\partial L}{\partial w} > 0$).

Therefore, the effect of a higher wage on supervisory resources has two components: the one is the effect of a higher wage on supervision for given employment (the 'direct' wage effect), which is negative as wage and supervision are substitutes in eliciting effort, and the other is the indirect effect of the wage operating through changes in employment, as the change in the wage will generate changes in employment and thus in supervision through the NSC. The sign of the latter effect is determined by the sign of the optimal change in employment generated by the wage increase ($\frac{dL}{dw}$), as supervision is increasing in employment, ceteris paribus, because an increase in employment will decrease the probability of detection and will increase the propensity to shirk ($\frac{\partial N}{\partial L} > 0$ by the NSC). Therefore, for motivation to remain at the same level, supervision should be increased, with everything else constant.

In this case the 'employment' effect on supervision is zero as $\frac{dL}{dw} = 0$, for a just binding minimum wage, implying that supervision decreases for a just binding minimum wage, and decreases by more for wage increases well above the equilibrium wage.

Additionally, it can be shown that, if there is a wage at which supervision is maximized, then this wage is non-binding, which further implies that a wage for which both employment and supervision increases is non-binding.

In general, a higher wage increases motivation and leads to a relaxation in monitoring intensity. Lower monitoring intensity essentially means less supervisors per employee or more workers per supervisor. This can be achieved if both the number of supervisors and employees decrease but the decrease is higher for supervisors or both supervisors and workers increase but the increase in the number of workers is higher[39] or even if the number of employees increases and that of supervisors declines.[40]

We show that, when the minimum wage is set infinitesimally above the equilibrium wage one of the polar case arises, i.e. employment is constant and supervision falls. Furthermore, it is also shown that the firm will never choose, to increase both employment and supervision or increase employment and decrease supervision, as optimal adjustments of the monitoring intensity after the imposition of a binding minimum wage. It is intuitive why the former adjustment cannot take place for a binding minimum wage, as profits fall and the firm will try to save resources somehow, which is not possible to be achieved by increasing all inputs, in this case.

The profit maximization problem, could have been solved by using (11) to express L as a function of w and N, and then substitute this into the profit function, derive the first order conditions w.r.t N and w, do the comparative statics for N, and then use the NSC to do the comparative statics for L. Using this latter way to treat the problem, the change in optimal L, by the NSC that expresses L as a function of w and N can be expressed as follows :

$$\frac{dL}{dw}=\frac{\partial L}{\partial w}+\frac{\partial L}{\partial N}\frac{dN}{dw} \quad (21)$$

[39] From equation (13) we get that $\frac{d(\frac{N}{L})}{dw} < 0$. Which implies that $E_w^N < E_w^L$, where E_w^N and E_w^L is the elasticity of supervisory resources w.r.t the wage and the elasticity of employment w.r.t the wage respectively.

[40] Note that there is also the polar case of employment to remain unchanged and supervision to fall or supervision to remain unchanged and employment to rise, with the latter not being possible as we discussed above.

Equation (21) decomposes the employment effect of a higher wage into the 'direct' wage effect (the first term) and the 'supervision' effect of the wage (second term). The 'direct' wage effect is positive, as a higher wage decreases the propensity of workers' to shirk, and thus monitoring can be relaxed by increasing employment assuming that supervisory resources are fixed. The second term expresses the 'supervision' effect of the wage and is negative as by the NSC $\frac{\partial L}{\partial N}$ is positive and because we also showed that $\frac{dN}{dw}$ is negative for all wages set above the equilibrium wage.

The above decomposition of the employment effect into the "direct" and the "supervision" effect of the wage can be used to explain the predictions of the seminal efficiency wage model of Calvo and Wellisz (1979), who also predict a positive employment effect of a just binding minimum wage, under a more general environment, with heterogeneous production employees and supervisors, and thus endogenous supervision.

Interestingly, as we also argued in one of the previous section, the Calvo and Wellisz model includes as a special case the framework used in the analysis of Rebitzer and Taylor, where production employees are homogeneous, and supervisory resources are fixed.[41] Thus, Calvo and Wellisz produce the same prediction as that produced by Rebitzer and Taylor 16 years earlier, something that has been neglected in the literature. The reason why Calvo and Wellisz mainly examined this special case is in order to show that the positive employment effect of a just binding minimum wage holds locally a fortoriori, and in par-

[41] As discussed also previously the general model of Calvo and Wellisz includes a multilayer (n layers) hierarchic firm, where employees in a layer of hierarchy are supervised by employees in the layer just above, and employees at the top layer are supervised by the owner of the firm. The case of fixed supervisory resources is the case of a one-layer organisation, where production employees are supervised by the owner of the firm.

ticular the range up to which one can increase the wage and increase employment is larger under fixed supervision relative to the case where supervision is endogenous.

Our analysis in this section can be compared with the special case of the model of Calvo and Wellisz, where there is a two layer hierarchic organisation, with homogeneous workers and supervisors. Calvo and Wellisz (1979) prove that optimal arrangements in the first layer are independent of the layer above. This property of their setting hinges on two things; on the assumption of constant returns to scale in efficient labour and on the trick that employers in the first layer choose optimally the number of workers per supervisor and not the actual number of workers. Given, this property of their setting, employers optimize in the first layer by choosing the number of production workers per supervisor, and then they set optimally the number of supervisors in the second layer, for given optimal arrangements in the first. This suggests that the optimal actual number of production workers, under this setting is the product of the first layer optimal arrangement for production workers and the second layer optimal arrangement for supervisors.

The latter discussion argues how the above decomposition of the employment effect into the "direct" and the "supervision" effect of the wage is also relevant for the two-layer hierarchic case of Calvo and Welliszs, as the overall employment effect depends on the effects of the wage for production employees, for given the number of supervisors in the layer above (the "direct" wage effect) and the effect on the employment of production employees generated by changes in the level of supervision due to the change in the wages of production employees produced by the minimum wage introduction/increase.

The result of Calvo and Wellisz that employment unambiguously increases and supervision falls is generated, because they show that for a just binding minimum wage (a minimum wage set infinitesimally above the optimal wage), employment increases but supervision is unchanged[42] which further suggests that there is a range to the left of the optimal wage, where if a binding minimum wage is set, supervision will fall, but actual employment will still increase (the 'direct' wage effect dominates the 'supervision' effect).

Our analysis shows (see section 2 of appendix at the end of the chapter for proof) that the result that the profit maximising wage is the supervision maximising wage, which is extremely critical for the increase in employment after the imposition of a just binding minimum wage is driven by the assumption of constant returns to scale, which is imposed by Calvo and Wellisz (1979) to generate a desirable property of their hierarchic setting (that optimal arrangements for production workers in the first layer of hierarchy are independent of the layers above).

We also show that if one assumes that production exhibits decreasing returns to scale in efficient labour, which as we also prove previously is the only case that arises naturally from the standard assumptions of the properties of the production function, that also hold for the model of Calvo and Wellisz, even a just binding minimum wage decreases supervision (see section 2 of appendix for proof) and thus ambiguity arises on the effect of a higher wage on the actual number of employees, under the Calvo and Welliszs setting. Therefore, we show that the fundamental result of two of the seminal efficiency wages models used in the analysis of the economic effects of the minimum wage, that a higher minimum wage

[42] This suggests that the profit maximizing wage is also the supervision maximizing wage and thus for all wages above this wage supervision falls.

will increase the employment of affected workers hinges critically on simplified and ad hoc assumptions.[43]

2.5 Empirical Relevance of the Theoretical Predictions

In the previous section we derived equation (21), which suggests that the total employment effect of the introduction/increase in the minimum wage can be decomposed into the "direct" wage effect and the "supervision" effect of the wage.

The 'direct' wage effect in this case is equivalent to the so-called 'employer-size' wage effect, that suggests that larger firms pay higher wages, which is a well-documented fact of the empirical literature of wage-determination (Lester 1967, Masters 1969, Mellow 1982, and Brown and Medoff 1989). This is because, according to the 'direct' wage effect firms that have more employees, for given supervisory capacity, they will pay higher wages because they will have more severe monitoring problems. The latter consists one of the explanations of the employer -size wage effect, based on more significant monitoring problems in larger establishments.[44]

The second term in (21) expresses the 'supervision' effect of a higher wage and is negative because a higher wage decreases supervision and less supervisors will lead to less employees by the NSC.

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[43] In section two of the appendix we show that this is true under the simplest case of the model of Calvo and Wellisz, where employment and supervision are homogeneous. However, the argument can be strengthened rather than weakened if the analysis is extended for heterogeneous workers and/or supervisors, because then, as it is easy to understand, and as also suggested also by the authors, any positive 'direct' wage effect and thus any (overall) positive employment effect of the minimum wage is less pronounced.

[44] Several explanations of the employer size wage effect-a well documented fact in labour economics-have been offered in the literature, its full explanation still remains a puzzle (Brown and Medoff 1989, Kruse 1992, Manning 2003).

We have shown above that the employment effect of a just binding minimum wage is zero, which means that the 'direct' wage effect is equal in absolute value to the 'supervision' effect. In general, if we assume that supervisory resources are held fixed to the initial optimal level and that they cannot adjust instantaneously to any exogenous shock (perhaps because supervision is solely based on capital services), the negative term in (21) vanishes and thus the employment effect is positive.

However, the positive employment effect is local, as one cannot increase the wage without limit and increase employment. Therefore an interesting implication of the above decomposition of the employment effect into the "direct" and the "supervision" effect of the wage is that employment can only increased as a result of a minimum wage introduction/increase only if supervision is assumed to be fixed, whereas employment is unchanged for a just binding minimum wage and falls for a minimum wage set well above the equilibrium wage, when supervision is flexible.

Therefore, we show that although the employment effect of a higher minimum wage is positive, when supervision is fixed, the positive employment effect doesn't persist when supervision is endogenized. This is another way to explain the positive employment effect of a binding minimum wage, under the efficiency wage shirking framework of Rebitzer and Taylor (1995), where supervision is assumed to be fixed and workers are homogeneous. Hence, we show that in this case, with more realistic assumptions about the nature of the labour market under study, more accurate predictions can be produced.

The predictions produced by the general model seem to reconcile with the recent evidence (Card and Krueger 1995, Dolado et al 1996, Neumark and Wascher 1999, Brown

1999, Dickens et al 1999, Machin et al 2003, Machin, Wilson 2004), that point towards either a small negative or a zero employment effect of the minimum wage.

Our model, that allows for two counteracting effects of the higher minimum wage on employment can better reconcile with the recent evidence (Card and Krueger 1995, Dolado et al 1996, Neumark and Wascher 1999, Brown 1999, Dickens et al 1999, Machin et al 2003, Machin and Wilson 2004), as it can also allow for the case where a small increase in the minimum wage has a small negative employment effect, compared to the standard monopsony or the model presented by Rebitzer and Taylor (1995), where an increase in the minimum wage unambiguously increases employment, provided that the minimum wage is not set too high.

We further believe that, our latter result is empirically relevant as it may also provide another theoretical explanation, of the evidence from the fast food studies in the US (Katz and Krueger 1992, Card and Krueger 1994,), where employment increased in low-wage restaurants compared to high wage restaurants in the same state, after the increase in the minimum wage.

There is evidence (Card and Krueger 1995), that in fast food industry high-wage restaurants are larger in size compared to low-wage restaurants. As the fast food industry is competitive, non-unionized and workers are relatively homogeneous (Krueger 1991, Card and Krueger 1995), monitoring problems may consist a potential explanation of the positive employer-size wage effect.[45] Moreover Krueger (1991) suggest that although jobs in the

[45] Other potential explanations as the threat arising from unionization, market power and heterogeneity of workforce (Brown and Medoff 1989) are dismissed.

fast food industry are highly routinised and capital intensive there remains some scope for employee shirking and Greenberger and Steinberg (1986) report various forms of workers' malfeasance in the fast food industry. There is also evidence from the US fast-food industry that are consistent with a trade-off between wages and supervision (Krueger 1991).

Given, the evidence, we can intuitively show how our extended shirking model and in particular the decomposition of the total employment effect expressed by equation (21) could explain the empirical evidence from the fast food industry. In particular, Rebitzer and Taylor show that the positive employment effect of the minimum wage is the case in their model because the labour supply at the firm level (or the wage-employment setting condition provided by the NSC) is upward sloping because of the imperfect observability of employees' effort.[46]

Intuitively, we would expect that the more imperfect is the observability of effort or the more severe the monitoring problems are, the more inelastic the "labour supply" will be under this setting, as for the same increase in employment, firms with higher monitoring problems have to pay higher wages.[47] Thus, the employer size wage effect can be explained by the fact that the labour supply is more inelastic in larger firms, as these firms face more severe monitoring problems, and this is why they have to pay a higher wage to elicit the

[46] As also discussed above this is because, under imperfect observability of effort, a marginal increase in the wage will decrease the probability of detection (as supervision is fixed), and increase the propensity of employees' to shirk, and this is why the wage should be increased to maintain effort at the initial level. Thus, imperfect observability of effort lead to a monopsonistic setting, where the marginal cost of labour is increasing in the number of employees.

[47] This can be better understood if one considers that in the extreme case where the observability of effort is perfect, labour supply at the firm level is horizontal, i.e. infinitely elastic with respect to the wage, as the model specialises to the standard model of perfect competition.

same level of effort, given also the same number of employees,with firms with less severe monitoring problems (see figure 2).

Moreover, the latter result can be used to present graphically the employment effect of a higher minimum wage. As figure 2 indicates, an increase in the wage has two effects: on the one hand employment increases as the higher wage enables the firm to expand employment along the upward sloping NSC (this is the "direct" wage effect), but on the other hand, the higher wage will lead to a reduction in supervision, and thus in the monitoring intensity which has as a result that the NSC tilts clockwise and becomes more steeper (the "supervision" effect of the wage), which in our case exactly offsets the positive "direct" wage effect.

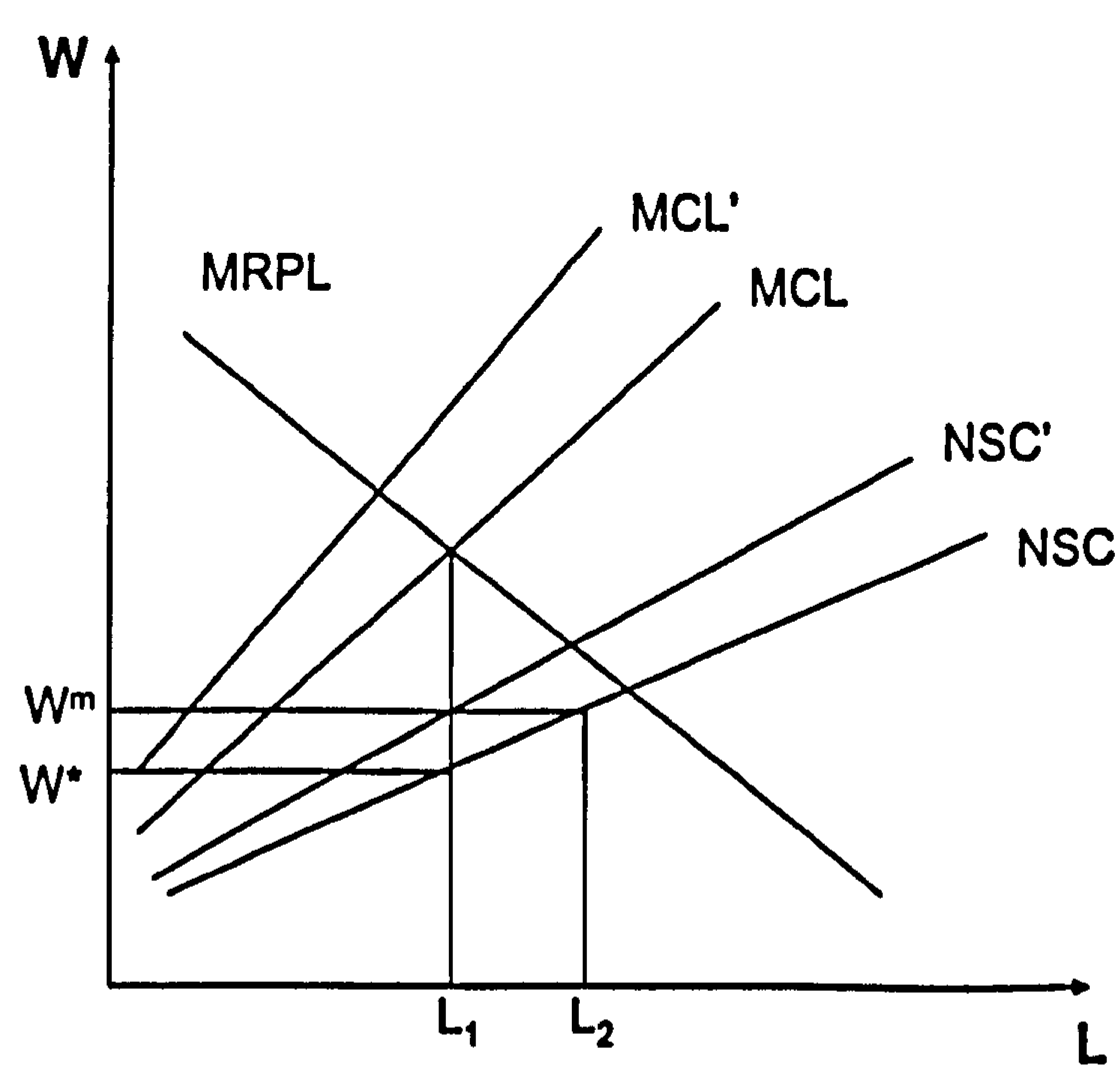

Figure 2.2: The employment effect of the minimum wage when supervision is endogenous.

Therefore, as the evidence suggests that high-wage fast food restaurants are larger in size, monitoring difficulties are expected to be more significant, and thus "labour supply" will be less elastic for these restaurants, ceteris paribus and thus employment is expected to increase more in low-wage, small restaurants, because of the larger "direct" wage effect, provided that the minimum wage is not set too high. Furthermore, one would expect that supervision will be more responsive to wage changes in larger restaurants, a fact which can be possibly explained by the physical structure of the fast-food restaurants, and thus the labour supply is expected to tilt more to the left for larger than for smaller restaurants.[48]

Consequently, our theoretical analysis, as summarized by equation (21) which reflects the standard decomposition of the employment effect of a higher wage into the 'direct' wage and to the 'supervision' effect of the wage, could possibly explain the employment gains in low-wage compared to high wage fast-food restaurants in the Texas and New Jersey-Pennsylvania studies, which were reported by Katz and Krueger (1992) and Card and Krueger (1994) respectively. In summary, the latter finding can be explained in terms of the higher probability of detection of a shirking worker, and the relative fixity of supervision in low-wage restaurants.

Finally, by showing how a shirking efficiency wages model can provide an ex post rationalisation of empirical findings on the effects of minimum wages in a low-wage labour

[48] A small fast food restaurant will probably use a supervisor in the kitchen to supervise employees that prepare the food and probably one in the cash-registers. Given this structure, it is quite hard, to imagine, given the limited space, that any change in the wage that will motivate employees will induce any significant changes in the supervision of a small restaurant. Because of this argument, we expect supervision to be relatively fixed in low-wage restaurants and quite flexible in high-wage establishments. Given, this last argument and our previous results that the employment effect of a higher wage is exaggerated, under fixed supervision, it is easy to understand why employment increased in low-wage relative to high-wage restaurants in New-Jersey and Texas.

market, we find some support to our initial perception that efficiency wage models can capture many features of low-wage labour markets and provide further important insight into the operation of these markets.

2.6 Extensions and Variants

In this section, we relax the assumption that the price of supervisory resources is exogenous and independent of the wage of workers.

We will assume that supervision is based solely on labour services and that the firm employs homogeneous workers who are randomly allocated across tasks (production and supervision). Therefore, the assumption we made for the workers side in the previous sections, hold in this section also for supervisors. There is imperfect observability of workers' effort and that is why the employer hires supervisors to monitor employees, and the employer, in turns monitor supervisors.[49] Let, the employer to have unitary supervisory capacity. Then the probability of detection or monitoring intensity of supervisors effort is given by the following equation:

$$Q = \min[\frac{1}{N}, 1] \quad (22)$$

, while the probability of detection of workers is, under this case given by:

$$P = \min[\frac{eN}{L}, 1] \quad (23)$$

[49] Although, this is a simplified version of the hierarchical model presented by Calvo and Wellisz (1979) it can capture the main features of their model and generate their main predictions.

if supervisors shirk ($e = 0$), then it becomes impossible to detect shirking workers and an infinite wage must be paid to workers in order to prevent shirking. Therefore, if supervisors shirk, workers will also shirk.

The employer must decide the optimal combination of carrots (wages) and sticks (dismissal threats based on supervision) to prevent shirking in production and supervision. We are interested for the case, where one in equations (22) and (23) is not binding. Furthermore, if we follow the standard procedure in order to derive the worker's and the supervisor's decision making condition and given that the industry in which the firm operates is covered by a minimum wage, the employer solves the following problem:

$$\max_{w,c,L,N} \Pi(w,c,L,N) = \max_{w,c,L,N} f(L) - wL - cN \quad (24)$$

$$\begin{aligned} s.t\, w &= \mu + e + \frac{e(r+s+q)}{(1-q)P} \quad (25) \\ c &= \mu + e + \frac{e(r+s+q)}{(1-q)Q} \quad (26) \\ w &\geq w_m \quad (27) \\ c &\geq w_m \quad (28) \end{aligned}$$

By (25) and (26) we have that homogeneous workers that are allocated in different tasks, which we will assume that are equally difficult, may receive different wages. The wage differential depends on monitoring difficulty, which is a standard result of the shirking model (Shapiro and Stiglitz 1984), that can explain the evidence of interindustry wage differentials (Krueger and Summers, 1988) that cannot be attributed to difference in workers' quality and working conditions suggested by the competitive model of the labour market.

The firm chooses the cost minimizing wages and thus the minimum wage constraints are both binding and (25) and (26) are equivalent to:

$$w_m = \mu + e + \frac{e(r+s+q)L}{(1-q)N} \quad (29)$$

$$w_m = \mu + e + \frac{e(r+s+q)N}{(1-q)} \quad (30)$$

By (29) and (30) we conclude that the cost minimizing firm will pay the same wages to workers and supervisors and supervise them by the same intensity, $P = Q$ or $\frac{N}{L} = \frac{1}{N}$. The model can be solved descriptively, as by (29) and (30), an increase in the minimum wage, firstly increases employment of supervisors, and since employment of workers is increasing in both quantity of supervisors and the wage, it increases employment of workers as well. Thus, this variant of the model generates a quite different prediction, as it allows for the case that both employment of production workers and supervisors increase as a result of a binding minimum wage.

However, this case differs from the general model analyzed in the previous sections as it assumes that there are shirking considerations for both workers and supervisors, both categories of employees are employed from the same pool of homogeneous workers, the capacity to supervise supervisors is fixed and there is initially a binding minimum wage, which when increased it increases both the wage of workers and supervisors.

This result seems rather intuitive: because of the fixed supervisory capacity of supervisory workers, if the firm wants to hire more supervisors it must pay a higher wage. The constant capacity to supervise supervisors, lead the firm to employee less supervisors, and thus leads to a lower probability of detection of shirking workers. Consequently the firm is supply constraint in terms of supervisors and for this reason is supply constraint in terms of workers as well. An increase in the minimum wage enables the supply constraint firm to employ more supervisors and thus more workers, leading to an increase in total employment.

The problem becomes slightly different if initially there is no binding minimum wage and employers choose wages optimally. We will analyze the effect of a higher minimum wage firstly for production workers and then for supervisors, under this framework. Solving (25) for N, plugging that in (26) and solve for c and use both constraints to substitute in the objective function for N and c as functions of w and L the first order conditions are:

$$\Pi_L = f_L - w - c_N N_L N - cN_L = 0, (31)$$

$$\Pi_w = -L - c_N N_w N - cN_w = 0, (32)$$

if a minimum wage for production workers is introduced[50] just above the optimal wage for production workers, then the direction of the change in the employment of workers will be determined by the sign of Π_{Lw}, as suggested by (18). Manipulating, (31) and using the fact that equation (32) holds, if the minimum wage is set infinitesimally above the wage of production workers, we get :

$$\Pi_{Lw} = -2c_N N_L N_w > 0, (33)$$

[50] We will assume that $P = \frac{N}{L} > Q = \frac{1}{N}$, and thus although workers and supervisors are employed from the same pool of homogeneous workers, supervisors are more difficult to monitor because of the constant capacity of the owner of the firm to supervise them and thus they will be paid a higher wage than workers. This is assumed in order that the binding minimum wage directly affects only the wage of production workers.

Therefore, by (33) employment of production workers increases, after the imposition of a just binding minimum wage. It can be also shown that, under the standard assumption of decreasing returns to scale in efficient labour units that we impose throughout our analysis, the increase in the wage of production workers which is induced by the introduction of a minimum wage that binds for supervised workers but not for supervisors, decreases the number of supervisors and thus decreases also their wage (see section 2 of appendix for proof). This further means that in this case, the 'direct' wage effect is positive and larger in absolute value from the 'supervision' effect for employment to rise.

As suggested above, and in previous sections, the analysis assumes decreasing returns to scale in efficient labour input. If one assumes that production technology exhibits constant returns to scale then, a just binding minimum wage doesn't affect supervision i.e. the profit maximizing wage is the supervision maximizing wage (see section 2 of appendix for proof), and thus again the employment effect of a just binding minimum wage is positive.

The explanation is that there is a left neighborhood of the optimal wage, in which if a minimum wage is set, given everything else, employment increases (the 'direct' wage effect is positive) and provided that for a just binding minimum wage the 'supervision' effect is zero and that the wage of supervisors remains also constant, the total employment effect is positive.

As this variant of our model is a simplified version of the model presented by Calvo and Wellisz (1979), who assume constant returns to scale in production, we demonstrate that employment increases for a just binding minimum wage and thus for a right neighborhood of the optimal wage, in Calvo and Wellisz (1979) because of the assumption of constant returns to scale, which if holds the 'supervision' effect is zero. Thus, this assumption is critical for Calvo and Wellisz in order to derive a positive employment effect of a minimum wage.

Moreover, as suggested also above and as it is demonstrated in the appendix (see section 2 for proof), if one assumes decreasing returns to scale (which is more realistic with only one input under the standard neoclassical production theory) then the 'supervision' effect of the higher wage is negative and the effect of the minimum wage on employment becomes ambiguous.

In this variant of our model which closely resembles the model of Calvo and Wellisz when employees are homogeneous and supervision is endogenous, we resolve any ambiguity and show that even under decreasing returns to scale and a negative 'supervision' effect employment of covered workers increases. However, although we manage to resolve the ambiguity on the employment effect of a minimum wage, when production exhibits decreasing returns to scale, in the simple case of the model of Calvo and Wellisz, in a more elaborate version of their model, where employees are assumed to be heterogeneous their prediction that an increase in the minimum wage unambiguously increases employment cannot be sustained.

This further suggests that the positive employment effect of a higher minimum wage (if it is the case) is less pronounced under not only endogenous supervision but also under employees' heterogeneity (see also section 3 of appendix). Finally, by direct comparison of the case where production is assumed to exhibit constant returns to scale compared to the case that exhibits decreasing returns to scale, and given the sign of the 'supervision' effect under the two cases, one can easily understand that the positive employment effect is more pronounced under constant returns to scale and the range up to which one can increase the wage and increase employment is also larger under constant returns compared to decreasing returns.

If, on the other hand the wage of supervisors is also increased because the minimum wage binds also for supervisors[51] then, both employment of supervisors and workers increases. The intuition is similar, as in the initial analysis in this section, where the minimum wage is a binding constraint for both workers and supervisors.

In this section we show that, if the assumption that supervisors do not shirk is relaxed, the effect of a higher wage on employment of covered homogeneous production workers is positive, for a just binding minimum wage and is negative for a sufficiently high minimum wage, as beyond the neighborhood of the optimal wage the supervision effect (which is negative) more than offsets the positive 'direct' wage effect of the wage and employment falls.

In the previous section we showed that the result of Rebitzer and Taylor (1995), that a higher minimum wage increases employment of covered workers, when supervision is fixed, cannot be sustained if the latter assumption is relaxed. As Rebitzer and Taylor assume also workers homogeneity and decreasing returns to scale in production, in this section we show that their result can be the case, under endogenous supervision for pro-

[51] Recall that we have assumed that the wage of supervisors is higher than that of production workers.

duction workers, if one assumes there are shirking considerations for all workers who are randomly assigned between production and supervision.[52]

However, this doesn't mean that their result of a positive employment effect is robust under endogenous supervision, as what we actually do in this section is that we push the fixity of supervision one stage back, which again is the main reason of the positive employment effect of the minimum wage. Moreover, we also show that Rebitzer and Taylor's prediction is less accurate than our model's prediction of the employment effects of the minimum wage, as it cannot explain a situation where a small increase in the minimum wage may have as a result a zero or a small negative effect.

The intuition for the positive employment effect of a just binding minimum wage derived in this section, is that an increase in the wage of production workers, will relax monitoring intensity. For given employment, monitoring intensity is relaxed by decreasing the number of supervisors, which has as a result an increase in monitoring intensity of supervisors and thus a decrease in their wage, as with tighter supervision supervisors' propensity to shirk falls and their wage can fall, for given effort. The fall in the number of supervisors and of the supervisor's wage enables the firm to free up some resources and hire extra employees.

[52] As discussed in the previous section the critical assumption that drives the result that a binding minimum wage increases employment of covered workers in the model of Rebitzer and Taylor is the exogeneity of supervision. We further showed in the previous section that if this assumption is relaxed the positive employment effect is no longer the case. In the simple extension of our model presented in this section the Rebitzer and Taylor result of a positive employment effect of a higher minimum wage can be produced even under endogenous supervision, because although supervision for production workers is endogenous, supervision for supervisors is fixed. Therefore, under the model of this section we actually push the assumption of fixed supervisory resources one stage back and that is why the same prediction with the Rebitzer and Taylor model is generated, at least qualitatively.

However, if the fall in the number of supervisors is dramatic this will further decrease monitoring intensity of production workers by more that it is required to just offset the increase in their wage and thus will increase workers' propensity to shirk which further should lead to a fall in the number of workers so that no employee shirks. Therefore, although a just binding minimum wage increases the employment of covered workers, a sufficiently higher minimum wage will decrease it.

Although, the sign of the prediction of Rebitzer and Taylor can be sustained under this different environment, the magnitude of the positive employment effect is smaller under endogenous supervision. However, we show that if one also assumes constant returns to scale the result of Rebitzer and Taylor can be sustained also in magnitude, as even when supervision is endogenous. a just binding minimum wage doesn't change supervision.

Although, in this chapter we show that, although the prediction of the a non-negative employment effect of a higher minimum wage produced by the seminal efficiency wage models may be criticised as not being so robust under more flexible settings, a generalised shirking efficiency wages model can still explain the non-negative employment effect of the minimum wage as suggested by recent evidence.

2.7 Conclusions

There are many theoretical arguments and observations from low-wage labour markets which suggest that because of valid restrictions in implementing first-best labour contracts, under asymmetric information, efficiency wages may arise as the optimal (second-best) solution to agency and adverse selection problems in low-wage industries. There is also evidence from low-wage industries that employers pay efficiency wages in minimum wage jobs (Holzer et al 1991, Krueger 1991). This is why, we believe that efficiency wages models that try to predict the employment effect of a binding minimum wage, may be particularly relevant in analyzing the effects of minimum wages in low-wage labour markets.

Theoretical models of efficiency wages are cited in the literature of the topic of the minimum wage (Brown 1999, Dolado 2000), as an alternative theoretical explanation of recent empirical findings which suggest that minimum wages may increase or may not affect employment of covered workers (Card and Krueger 1995, Machin and Manning 1994, Dolado et al 1996) and cast doubt on the traditional view of labour market operation.

Nevertheless, theoretical work on the employment effects of the minimum wage, under efficiency wage considerations seems incomplete, as some of the existing seminal models (Calvo and Wellisz 1979, Rebitzer and Taylor 1995, Manning 1995) do not account for some important features of low-wage labour markets and thus their results may hinge heavily on their simplified assumptions.

In this chapter we extend the shirking-efficiency wages model of Shapiro and Stiglitz (1984) which was suitably modified by Rebitzer and Taylor, to provide an explanation of a positive employment effect of the minimum wage, in order to allow for endogenously determined supervision. Our model, enables us to assess the robustness of the main prediction of the existing efficiency wage models of the minimum wage that an increase in the minimum wage may increase employment, when a more realistic features of the low-wage labour market and firm's operation is taken into account but more importantly the model allows us to produce more accurate theoretical predictions on the employment effects of the minimum wage, which also better reconcile with the recent important empirical evidence, than some of the existing seminal models.

We show that under the fundamental prediction of the model of Rebitzer and Taylor that a higher minimum wage may increase the employment of covered workers is not robust to relaxation of the simplified assumption of fixed supervisory resources, and that once supervision is treated as endogenous, a just binding minimum wage has no effect on employment, whereas a higher minimum wage will reduce employment. We also show that the positive minimum wage employment effect predicted by the seminal model of Calvo and Wellisz hinges critically on the assumption of constant returns to scale in production and cannot be sustained under the more realistic assumption (under standard conditions) of decreasing returns to scale.

We also show that the employment effect of the minimum wage can be decomposed into two distinct effects; the 'direct' wage effect and the 'supervision' effect of the wage. The two components of the minimum wage employment effect are counteractive, and this is why our extended model can better reconcile with the empirical evidence of the minimum wage literature that support a zero or moderate negative employment effect of a minimum wage introduction/increase (Card and Krueger 1995, Dolado et al. 1996, Brown 1999, Dolado et al. 2000, Machin et al 2003, Machin and Wilson 2004).

We further show how our latter prediction of the decomposition of the employment effect of the minimum wage could provide an alternative theoretical explanation of the striking evidence of the US fast-food industry studies (Katz and Krueger 1992, Card and

Krueger 1994), which find that employment has increased more in low-wage, more affected by the minimum wage restaurants relative to high-wage, less affected restaurants.

Thus, as theoretical models should be judged by the realism of their assumptions, but mainly also by the accuracy with which they can predict observed phenomena, our main contribution is to further demonstrate the insight that efficiency wage theory can provide on the economic effects of the minimum wage and on the workings of low-wage labour markets

2.8 Appendix

2.8.1 Diminishing Marginal Productivity with One Input Implies Decreasing Returns to Scale in Production

Suppose the production function $f(\cdot)$ is a function of one input x, where $x \in \Re_{+}^{*}$ and $f(0) = 0$, and that there is diminishing marginal productivity of the single input, i.e. $f' > 0$ and $f'' < 0$. In order to show that the production technology exhibits decreasing returns to scale in the single input we need to show that:

$$f(\lambda x) < \lambda f(x), \text{ for all } \lambda > 1 \ (A1.1)$$

From concavity and assuming that $\lambda > 1$, we have that the following condition is true:

$$f'(\lambda x) < f'(x) \ (A1.2)$$

By multiplying both sides of $(A.2)$ by λ we obtain $(A.3)$:

$$\lambda f'(\lambda x) < \lambda f'(x) \ (A1.3)$$

$(A.3)$ can be also expressed as follows:

$$\frac{df(\lambda x)}{dx} < \lambda \frac{df(x)}{dx} \ (A1.4)$$

By integrating both sides in the interval $[0, \gamma]$, where $\gamma \in \Re_{+}$ and given that $f(0) = 0$, we get:

$$f(\lambda\gamma) < \lambda f(\gamma)\ (A1.5)$$

and condition $(A1.5)$ holds for all $\gamma \in \Re_{+}$.

2.8.2 The Effects of the Minimum Wage, when Workers are Homogeneous and are Randomly Assigned between Employment and Supervision

From (20) we have

$$\frac{dN}{dw} = N_w + N_L \frac{dL}{dw}\ (A2.1)$$

and from (31) if we differentiate w.r.t L, and using that that $c_{NN} = N_{LL} = 0$ from (13) and (26) we have:

$$\Pi_{LL} = f_{LL} - c_{NN}(N_L)^2 N - c_N N_{LL} N - 2c_N(N_L)^2 = f_{LL} - 2c_N(N_L)^2\ (A2.2)$$

From $(A2.2)$, (17), (33) and if the production function exhibits constant returns to scale in efficient labour units, we get that;

$$\frac{dL}{dw} = -\frac{N_w}{N_L}\ (A2.3)$$

Therefore, from $(A2.1)$ and $(A2.3)$ it is derived that:

$$\frac{dN}{dw} = 0\ (A2.4)$$

Thus, it is derived that under homogeneous workforce, with constant returns to scale production technology, the profit maximizing wage is the supervision maximizing wage and the 'supervision' effect of a just binding minimum wage is zero, which in turn implies that the employment effect of a just binding minimum wage, under endogenous supervision is identical with the employment effect, under the assumption that supervision is fixed.

This is exactly the case in Calvo and Wellisz (1979). However, although the effect of a just binding minimum wage is the same under exogenous and endogenous supervision, any positive (negative) employment effect of a minimum wage set above the range of the optimal wage will be more (less) pronounced when supervision is exogenous than when it is endogenously set. This also implies that the range up to which one can increase the wage and increase employment will be also longer under exogenous than under endogenous supervision. Calvo and Wellisz do not explicitly show this on their model.

Moreover, we will show that if the production technology exhibits decreasing returns to scale supervision falls for a just binding minimum wage.

By ($A2.1$), (17), (33) and ($A2.2$), assuming also decreasing returns to scale in production the effect of a just binding minimum wage on supervision is given by the following equation:

$$\frac{dN}{dw} = N_w + N_L\left[-\frac{-2C_N N_L N_w}{f_{LL} - 2C_N(N_L)^2}\right] < 0 \quad (A2.5)$$

If the f_{LL} term vanishes, which the case under constant returns to scale then ($A2.5$) is equivalent to ($A2.4$). This suggest that the only difference between the two cases is the negative f_{LL} term, which appears in the denominator of the expression for $\frac{dL}{dw}$, by (17), Thus, the second term in ($A2.5$) which is positive and expresses the positive 'employment' effect of the wage on supervision is smaller than in ($A2.3$) and since in ($A2.4$) it has been shown that the term N_w, which is negative is equal in absolute value to the full expression to the right of the summation sign, it is easy to understand that the full expression in ($A2.5$) is negative. This result demonstrates, that under decreasing returns to scale, and under the assumptions of shirking considerations of employees who are randomly assigned to production or supervision, the effect of a just binding minimum wage on supervision is negative.

Therefore, if in Calvo and Wellisz model one relaxes the assumption of constant returns to scale and instead assumes decreasing returns to scale the effect of a just binding minimum wage on total actual employment becomes ambiguous, as supervision falls for a just binding minimum wage whereas employment of production workers per supervisor increases.

Chapter 3
Carrots and Sticks: Efficiency Wages Evidence from the 1990 British Workplace Industrial Relations Survey

3.1 Introduction

The main assumption of efficiency wages models and their main deviation from the standard neoclassical or competitive model of the labour market is that wages affect workers productive behaviour.[53] If information about the worker's actions or type is imperfect and the required productive behaviour or quality of workers cannot be enforced or elicited costlessly, then it may be optimal for employers to pay above the worker's outside option[54] or the market clearing wage.[55]

The optimal above-market clearing (efficiency) wage is set so that its marginal benefit[56] is equal to its marginal cost. In general equilibrium, and provided that firms are

[53] In particular higher wages increase workers' effort (Solow 1979, Yellen 1984, Stiglitz 1986) or prevent shirking (Shapiro and Stiglitz 1984), improve the average quality of a firm's applicants pool (Weiss 1980, 1990), decrease quits and turnover (Salop 1979) improve morale and workers association with the firm (Akerloff 1982, 1984), as well as decrease collective disruptive behaviour (union threat) (Dickens 1986).

[54] Alternatively, and in particular under agency problems, employers may use bonding, incentive contracts in which compensation is tied to outcomes (Milgrom and Roberts 1992) or tournaments (Lazear and Rosen 1981) to overcome the problem of asymmetric information. All the above types of labour contracts are more efficient than efficiency wages (Weiss 1990, Milgrom and Roberts 1992), but when they are not feasible, efficiency wages are to be preferred.

[55] It is the wage premium above the market clearing wage and not the wage per se that affects workers' productive behaviour in general equilibrium.

[56] According to the main assumption of efficiency wage models, higher wages generate benefits to firms by increasing profits through higher labour productivity induced through higher effort, and lower turnover, shirking and malfeasance costs.

identical, if firms find optimal to pay an above market clearing wage[57] then this will result in involuntary unemployment, as workers that want to work at a lower than the efficiency wage will not be able to find a job.

Therefore, the efficiency wage theory offers an explanation of involuntary unemployment as it can explain why wages do not fall for the labour market to clear (Akerloff and Yellen 1986, Katz 1986, Weiss 1990). It is also true that efficiency wages theory can explain other labour market phenomena as wage differentials of equally skilled workers (Krueger and Summers 1988, Gibbons and Katz 1992) in the same occupation and dual labour markets (Jones 1985, 1987, Bulow and Summers 1986).

In general the source of the problem is that, according to the efficiency wage theory, wages are used by employers as a personnel policy device to recruit, retain and motivate employees as well as to determine employment (Layard, Nickell and Jackman 1991). Thus, if another mechanism could serve the first role, then firms would pay the lowest possible wage that will satisfy their labour demand and the labour market will clear.[58]

An alternative device to higher wages that serves in motivating and retaining employees is bonding[59]or entry fees which are repaid to workers towards their working lives, where workers are forced to post a bond when join the firm, which they will forfeit when

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[57] The market clearing wage is equal to worker's alternative value of time, which is the minimum level of the wage at which employees would be willing to accept the job (the worker's reservation wage). The efficiency wage by construction exceeds the market clearing (reservation) wage by a wage premium that is paid in order to elicit the required behaviour or quality of workers.

[58] Provided that another mechanism is used to perform the personnel management role of wages, firms would like rationally to set the wage to minus infinity! However, to ensure workers participation firms pay the worker's outside option so that labour supply meets labour demand and the market clears.

[59] This is an efficient mechanism as it does not alter the present discounted value of compensation compared to the full information case (Lazear 1979, 1981, Krueger 1991), but it alters the slope of the tenure/earnings profile.

they quit or found shirking (Weiss 1990). Partly for legal reasons or because of capital market imperfections we rarely observe any explicit bonding where workers have to pay a lump sum amount when join the firm (Katz 1986, Rebitzer 1989, Ritter and Taylor 1997) but we do observe entry fees in the form of lower wages for newly hired workers (Lazear 1986, Krueger 1991).

However, lower starting wages and steeper tenure/earnings profiles are subject to moral hazard problems as it is the case that the firm will have an incentive to fire the worker at the timing the entry fee must be refunded (Weiss, 1990). Moreover, bonding cannot be used by firms to tackle any adverse selection problems (Katz 1986, Rebitzer 1989, Weiss 1990, Ritter and Taylor 1997) .

In Dickens, Katz and Lang (1985) it is argued that the payment of efficiency wages cannot be ruled out on a priori theoretical grounds. The main argument against efficiency wages is that, it is not an efficient way to induce motivation or prevent workers malfeasance. The efficient way is bonding,[60] which seems to be limited because of capital market and other constraints, and also because it is observed that employers devote a considerable amount of resources in monitoring (Dickens, Katz and Lang 1985). Given, that bonding is not feasible[61] because of the theoretical considerations above, efficiency wages may be a second best mechanism that elicits productivity and enhances quality of employees.

[60] Efficiency can be also achieved by other forms of incentive contracts that can allocate resources as in the full information case. In the case that private information renders the full information outcome non-feasible, then any incentive efficient contract is to be preferred (Milgrom and Roberts 1992).

[61] See also Weiss 1990, Stiglitz 1987, Ritter and Taylor 1997 for an analytic discussion on the alternatives to efficiency wages and their limitations.

In sum the relevance of efficiency wages is an empirical not a theoretical question. In particular, whether wages substantially affect aspects of employees' productivity, and whether employers pay efficiency wages as a personnel policy device instead of using alternative mechanisms, are matters that can only be resolved empirically.

Even though there are numerous empirical studies of efficiency wages, it is generally agreed that there is no convincing evidence of efficiency wages as there are many problems that render the empirical investigation of efficiency wages particularly vexing (Cappelli and Chauvin 1992, Rebitzer 1995). Moreover, different empirical methodologies have been adopted in the empirical analysis of efficiency wages that each has its qualifications and limitations but no methodology seems to address effectively the main empirical problems and provide persuasive evidence that support or dismiss efficiency wage theories (Manning and Thomas 1997, Autor 2003).

In this chapter, we provide an empirical test of efficiency wage theory by testing the prediction of the 'shirking' and 'gift-exchange' models of efficiency wages that in equilibrium there is a trade-off between higher wages and supervision using establishment level data from the British Workplace Industrial Relations Survey (WIRS) of 1990.

In the case of unskilled manual employees, we find that the endogeneity bias generated by omission of factors that are correlated with wages and supervision intensity is expected to be positive and thus it may mask any wage-supervision trade-off that may be in operation. This latter finding may provide some support to efficiency wages, as the main omitted factors considered are correlated with wages and supervision only under an efficiency wage rational of wage and supervision determination.

Moreover, we also find evidence of a significant negative relationship between wages and supervision for unskilled manual employees across privately-owned, non-unionised establishments. This finding is not only consistent with efficiency wages, as there are other explanations of the wage-supervision trade-off provided in the literature, one of which is developed in this chapter. In particular, our novel theoretical explanation suggests that a negative relationship between wages and supervision may be the result of unobserved differences in union bargaining power across firms when there is firm-union bargaining over effort and unions 'like' wages and 'dislike' supervision.

We further try to sort out alternative theoretical explanations of the wage-supervision trade-off, using the evidence on the sign of the endogeneity bias. Our analysis seems to provide stronger support to the efficiency wage rational of wage/supervision determination- that wages and supervision are substitutes in eliciting higher effort by unskilled manual employees- than alternative theories.

However, as the latter evidence is necessary but not sufficient for the validity of efficiency wages we also test whether employers paid efficiency wages in order to elicit productive behaviour by unskilled manual workers by increasing the wage up to the point where the marginal cost of the wage is exactly offset by a fall in supervision costs. The main conclusion of the test is that we cannot dismiss the payment of efficiency wages to unskilled manual workers.

For semi-skilled and skilled manual workers, although the pattern of findings is similar to that of unskilled and seems consistent with a positive omitted variable bias, we find no evidence of a significant positive bias in the coefficient of interest and no systematic evidence of a negative relationship between wages and supervision. Finally, in the case of skilled workers we find evidence that provide some support to our prediction that unobserved variation in union bargaining power across establishments may cause a negative bias in the estimated coefficient of supervision intensity included in skilled wage equations.

As the data are not drawn from a particular industry, but for many different sectors throughout the British industry our findings can be generalised and seem to provide some support to the hypothesis that efficiency wages considerations may be valid for relatively less-skilled, low-wage employees which may further imply that the efficiency wage theory could provide particular insight into the workings of low-wage labour markets.

The remainder of the chapter is organised as follows: In section 2 we present a review of the empirical studies of the efficiency wage theory and their main qualifications and limitations, whereas in section 3 we present a sketch of our methodology and summarise the main competing theoretical explanations of the wage-supervision trade-off as well as the main empirical problems hindered empirical studies of efficiency wages. In section 4 we present a discussion of the limitations and qualifications of our data and in section 5 we present the estimation results for unskilled, semi-skilled and skilled manual workers. Finally in the last section we offer a summary and the main conclusions of the chapter.

3.2 Review of the Literature

The main empirical question of efficiency wage theory is twofold: Is it true that wages affect workers' productivity? And if it is true then: Do employers consider as optimal to pay above market clearing (efficiency) wages, instead of using alternative devices (for example lower starting wages), to elicit the required productive behaviour or quality of employees? (Cappelli-Chauvin1991, Manning and Thomas 1997).

Testing only a weak form of the above main empirical hypothesis of efficiency wages would be to test whether or not wages affect productivity, which consists a necessary but not sufficient condition[62] for efficiency wages to hold.

There are several studies that test whether or not higher wages contribute to output by estimating production functions with wages included together with other inputs (Wadhwani and Wall 1991, Levine 1992, Konings and Walsh 1994). These kind of studies suffer from the fact that there are unobserved factors that affect productivity and are correlated with wages. In these studies, there is also the econometric problem of identification; Are wages the cause or the result of higher productivity? (Cappelli and Chauvin 1991)

Moreover, as we argued above, this kind of evidence is necessary but not sufficient to make the efficiency wages story valid and that is why it is also important to provide evidence that employers set wages above the market clearing level to induce worker productivity.[63]

The main problem in testing this latter (optimality) condition of efficiency wages is that most of the times the gains of higher productivity or quality of employees induced by higher wages are difficult to measure, as efficiency wages arise in situations where workers' actions and quality are private information (Rebitzer 1995). Moreover, another problem

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[62] As discussed above two conditions must be satisfied simultaneously for efficiency wages to hold: a) wages should affect worker's productivity and b) employers should find optimal to set wages above the market clearing level in order to elicit the required action or quality of employees. The above two conditions are necessary and sufficient for the validity of efficiency wages.

[63] In other words wages are set optimally so that the marginal benefit of the wage is equal to the marginal cost.

could be that wages are not set unilaterally by employers, as unions and other institutions (minimum wages for example) may intervene in the wage determination process.

The latter point, consists the major criticism of the validity of the findings of one of the most credible attempts to provide evidence on efficiency wages, presented by Cappelli and Chauvin (1991). On the one hand, Cappelli and Chauvin's analysis addresses some of the standard empirical problems discussed above, but on the other hand in their setting, wages are not set unilaterally but are the result of collective bargaining at the company level (Manning and Thomas 1997).[64]

A second type of evidence on efficiency wages is evidence from the wage structure. In particular studies of interindustry wage differentials (Dickens and Katz 1987, Krueger and Summers 1988), provide evidence that unobserved differences in human capital and working conditions cannot explain a major component of the variation in wages, a finding which may suggest that the remaining variation could be attributed to efficiency wages.

However, this evidence does not consist, explicit evidence of efficiency wages as there is a considerable literature on whether these industry effects actually exist (Murphy and Topel 1987, Gibbons and Katz 1992) but even if they do exist, according to Manning and Thomas (1997) their relationship with efficiency wages is tenuous. An explanation of this latter criticism may be that inter-industry wage differentials suggest ex post rents in certain jobs, as suggested by lower turnover and longer tenure in high wage 'premium'

[64] Cappelli and Chauvin test empirically the relationship that higher wages are associated with lower level of shirking, that is generated by the Shapiro and Stiglitz (1984) shirking model of efficiency wages. Although, their data allowed them to deal with the identification problem mentioned above and any empirical problems caused by unobserved heterogeneity, their evidence that there is a negative correlation between wages and disciplinary dismissals provides support only to one of the necessary and sufficient conditions of empirical efficiency wages tests, namely that wages affect employees' productive behaviour. However, Autor (2003) explains that this is 'as good as it gets'.

jobs (Krueger and Summers 1988), whereas evidence on ex ante rents would potentially be more convincing (Autor 2003).[65]

Additionally, efficiency wages may also offer a potential explanation of why larger firms and firms with higher profits pay higher wages, which consist two well-documented facts in the wage determination literature.[66] However, there is no evidence to support the efficiency wages explanation of the employer size and profit effects on wages (Kruse 1992, Ewing and Payne 1999, Brown -Medoff 1989, Blanchflower et al. 1996).

Given the problems of the above type of empirical studies, alternative ways have been also suggested in order to test the validity of efficiency wages theories. In particular, an indirect way of testing the effect of wages on productivity is to test the relationship between wages and other means of regulating the activities of employees. If high wages elicit productivity or quality enhancing actions from employees then, all else equal, high wages employers should devote fewer resources to monitoring and checking worker activities (Rebitzer 1995).[67]

Particularly, an inverse relationship between wages and supervision intensity is a prediction of both the 'shirking'(Shapiro and Stiglitz 1984) and the 'gift-exchange'(Akerloff 1982) model of efficiency wages, although this occurs via different mechanisms.

[65] This kind of evidence are provided by Holzer, Katz and Krueger (1991) who find that there exist workers queues in minimum wage jobs which further implies the existence of rents at these jobs. However, once more efficiency wages is one of the potential explanations of the findings of the Holzer et al's study.

[66] For example, as in larger firms it is more difficult to detect shirkers, given everything else equal, wages must rise to prevent shirking (Brown and Medoff 1989, Kruse 1992). Moreover, in the absence of collective bargaining, workers may expect to be paid more if the firm is profitable and to slack off if they are not paid more (rent sharing hypothesis of efficiency wages see Layard et al. 1991)

[67] This holds, given that monitoring increases motivation, as there are theoretical models predicting the opposite (Frey 1992).

In the shirking model[68] an increase in the wage, provided that everything else is constant, increases the penalty to the shirker when is caught and being dismissed and thus discourages shirking.[69] On the other hand, effort is increasing in monitoring intensity, again ceteris paribus, because this increases the probability of detection of a shirking worker which in turn decreases the expected payoff of shirking and thus induces more motivation. Given that effort is increasing in both the wage and monitoring intensity, we expect that these motivation devices are substitutes in eliciting effort,[70] which implies that, in equilibrium, an increase in the one, for given effort, will result in a decrease in the other.[71]

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[68] Under the shirking framework (Shapiro and Stiglitz 1984) from the worker's decision problem between working and shirking it is derived the so-called 'non-shirking condition' which determines the wage necessary to prevent shirking, as a function of exogenous parameters, including effort. In this version of the shirking model, for simplicity effort is binary (0 if shirk, 1 if work) and monitoring technology is also exogenous. Under a continuous effort version of the shirking model (see chapter 2 and Georgiadis, 2001), the non-shirking condition can be used to express effort as an increasing function of the efficiency wage and monitoring intensity which is usually approximated by the ratio of supervisors to staff.

[69] This can be thought as a substitution effect of an increase in the wage on the worker's effort choice, which means that the shirking model may neglect any income effect of a higher wage on the choice of the effort level by employees. This is because in general the decision of effort supply by employees can be thought as equivalent to the supply of the intensity of work i.e how hard one will work, which can be modelled similarly to labour supply (how much one will work). Thus, an increase in the wage on the one hand increases effort because leisure in terms of shirking becomes more expensive (substitution effect or higher expected cost of shirking) but on the other hand decreases effort, as income increases and given that leisure is a normal good, less effort will be provided (income effect). Since the income effect of a higher wage should be present, strictly speaking the shirking model should implicitly postulate that the income effect is sufficiently small so that effort is increasing in the wage.

[70] The wage premium and monitoring intensity are also substitutes in production. This is because, under a production function with efficient labour inputs (a combination of the number of employees and the intensity they work), an increase in the wage, given everything else constant, increases effort and so output, and thus monitoring intensity must fall for output to remain constant. Therefore, isoquants as well as isoeffort curves slope downwards in the wage-monitoring intensity space. In other words the marginal rate of substitution between wages and monitoring intensity is negative. In general, there are many channels via which wages may affect output and thus wages can be incorporated in the production function directly or indirectly via an effort or quit function for example.

[71] As suggested by Bowles (1995) and Gordon (1990, 1993) inter alia, one should expect that at sufficiently low levels of supervision, wages will have a minor or negligible effect on employees effort, irrespective of how high they are set as the threat of losing the wage premium is not credible. The same holds for supervision intensity at sufficiently low wages. This point doesn't suggest that wages and supervision are complements but instead suggests that isoeffort curves are decreasing and convex in the wage-supervision intensity space.

In other words, in equilibrium, if the wage is increased this will decrease the propensity of a worker to shirk, and for given effort, monitoring intensity must be relaxed and vice versa. Therefore, for given employee's effort there is a trade-off between wages and monitoring intensity.

In the 'gift-exchange' model, supervision is not central to the problem of motivation. Rather firms devote resources to supervision in order to coordinate the activities of the direct producers and ensure product quality ex post (Rebitzer 1995). Under, this model higher pay is considered as a 'gift' that appeals to norms of reciprocity, and thus induces more effort and substitution of self-monitoring for external monitoring. Thus, there are two different mechanisms via which the wage-supervision trade-off may result, in efficiency wage theory.[72]

A potential virtue of this testing approach of efficiency wages is that the benefit of the wage can be explicitly measured by gains in terms of supervision costs, which implies that one can test, given an estimate of the wage-supervision trade-off, if the increase in the wage costs is exactly offset by a decrease in supervision costs and thus whether wage increases 'pay for themselves' (Levine 1992). This condition can be quite informative as far as the validity of one of the conditions of efficiency wages discussed above, even under the problems, that arise by unions and other institutional interventions in the wage determination.[73]

[72] There is a subtle difference between the two models. In the gift-exchange model, employers set wages directly and via wages supervision intensity is also determined. Thus, under this model wage changes have an effect on supervision because wages appeal to norms of reciprocity and not the other way around. In the contrary in the shirking model a change in the wage have an effect on the level of supervision and vice versa.

[73] In the presense of collective bargaining and given that there are valid efficiency wages considerations, under certain conditions, we would expect that the minimum level that the wage can be set is the efficiency wage. Therefore, if the comparison of marginal benefit and marginal cost of the wage suggests that wages are

Empirical tests of efficiency wages that are based on the investigation of the relationship between wages and supervision have been mainly hindered by the problem of endogeneity bias in the estimates of interest. The first two sources of endogeneity bias are omitted variables and simultaneity, as the supervisor to staff ratio which is the most usual proxy for the intensity of monitoring, is endogeneously and simultaneously determined with wages (Groshen and Krueger 1990, Krueger 1991, Rebitzer 1995). The third source of endogeneity is due to measurement error, again resulting because of the use of the ratio of supervisors to staff as a proxy for monitoring, as it may be the case that supervisors spend only a fraction of their time monitoring production employees (Rebitzer 1995, Brunello 1995).

Another important criticism, that is often been neglected in the literature, is that testing the wage-supervision trade-off is not equivalent as testing efficiency wages, firstly because there are also other explanations of the trade-off than efficiency wages (Kruse 1992) and second because any evidence of a wage-supervision trade-off is viewed as indirect evidence of effects of wages on workers productive behaviour, which is a necessary but not a sufficient condition for the validity of efficiency wages (see following sections).

Some of the empirical studies of the relationship between wages and monitoring or supervision include Fitzroy and Kraft (1986), Leonard (1987), Neal (1993), Brunello(1995). Fitzroy and Kraft (1986), investigate the effects of profit-sharing on factors' productivity using a sample of workers from 65 West German firms from the metalworking industry,

set below the efficiency wage level, and provided that union bargaining over wages imposes another binding constraint on wage determination, then this can be clearly interpeted as evidence that dismiss the validity of efficiency wages, even under union intervention.

and find an insignificant effect of the ratio of skilled to unskilled workers on profit sharing income of employees. Moreover, Leonard (1987) estimated wage equations including as a proxy for monitoring the supervisor to staff ratio for six occupations in a sample of US high-technology firms but finds a positive and insignificant relationship between pay and supervision in all occupations.

Similarly, Neal (1993) uses supervision data from the 1977 wave of the Panel Survey of Income Dynamics, in order to investigate whether interindustry wage differentials can be explained by differences in supervision by particularly looking whether workers in high wage industries enjoy more autonomy on the job which is an implication of dual labour markets arising from differences in monitoring problems (Bulow and Summers 1986). Neal finds that workers in high-wage industries are at least as intensively supervised as low-wage, secondary sector workers, and that no evidence can be provided that inter-industry differences in monitoring contribute to inter-industry wage differentials.

Brunello (1995) explores the relationship between pay and both the quantity and quality of supervision using data from the New Earnings Survey over the period between 1975-1982. The main finding arising from Brunello's analysis is that the wage-supervision trade-off turns insignificant once the quality of supervision is included in the wage equation which further suggests that errors in the measurement of supervision affect the outcome of the empirical investigation of the wage-supervision trade-off.

Finally Goldin (1986) suggests that sex segregation across jobs within manufacturing and the standardisation and division of tasks in female dominated occupations that made monitoring easier may explain the finding that there is sex-discrimination over pay in manufacturing.

Two other studies that find evidence that supports the wage supervision trade-off are presented by Kruse (1992) and Ewing and Payne (1999). Kruse estimates wage equations using data from the 1980 Survey of Jobs Characteristics, and he finds evidence that supports a negative relationship between wage and supervision. In particular, Kruse (1992) finds that daily supervised workers receive 1.2 per cent lower pay than their weekly supervised colleagues, ceteris paribus.

Similarly, Ewing and Payne (1999) using a sample of workers from the National Longitudinal Survey of Youth, find a negative relationship between their measure of supervision and reported wages. The common criticism of all the above studies is that they suffer from the endogeneity problem discussed above.[74]

Very few studies have managed to tackle the endogeneity problem successfully by exploiting policy or other interventions, which cause exogenous and independent variation in the intensity of supervision. In fact we know three such studies;

One of these studies is presented by Groshen and Krueger (1990), who exploit the fact that the number of supervisors to staff in the U.S hospital industry is often regulated by state and local (city) authorities and that is why the mandated supervisor-to-staff ratio varies by occupation and city. Thus, differences in the regulated supervisor-to-staff ratio,

[74] Brunello (1995) and Brown and Sessions (2002) use instruments for supervision intensity but the validity of their instruments is based on strong assumptions. Furthermore, there are studies which suggest that the endogeneity bias is expected to be positive and thus to mask any wage-supervision trade-off in operation, a claim that may explain why some of the studies discussed in this section rendered inconclusive. The positive sign of the endogeneity bias is often used as an argument to support the validity of the findings of studies that found a negative wage-supervision relationship and that do not effectively address the endogeneity problem (Kruse 1992, Ewing and Payne 1999, Brown and Sessions 2002).

across standard metropolitan statistical areas in BLS data cause exogenous variation in the supervisor/supervisee ratio. Groshen and Krueger find evidence in favour of a trade-off between wages and supervision only for the nursing occupation.

The second study is presented by Krueger (1991), who exploits the institutional arrangements of the franchise system in the fast food industry, which are the reason for inferior monitoring in company owned relative to franchisee-owned outlets. Krueger, finds that compensation is not only higher in company compared to franchisee-owned outlets, but it is also increasing faster with tenure in company-owned outlets.

Finally, Rebitzer (1995) exploits the fact that in petrochemical industry there are contract employees who are working in the plant, and their recruitment, payment and other employment practices are determined by the contractor employer who sets an agreement with the host employer. However, because of the high risk on the job in petrochemical plants, the host employer must also monitor contract employees, for safety reasons. Thus, host supervision is uncorrelated with the wage and other employment practices. Again Rebitzer finds evidence in favour of the trade-off between wages and supervision.

A limitation of the above three studies is related to their main virtue, as they are focusing on specific industries, where specific conditions allow investigators to address the endogeneity problem and thus their results cannot be generalised. Finally, another major problem that is shared between all studies of the wage-supervision trade-off (irrespective if they address the endogeneity problem or not) is that they fail to sort out alternative explanations of the wage-supervision trade-off[75] but even if this is the case, another problem is

[75] For example in Krueger (1991) an alternative interpetation of the finding of a wage-supervision trade-off except of that of more acute agency problems in company-owned restaurants is provided by 'expense

that any evidence of a wage-supervision trade-off arising from agency problems cannot be considered as evidence in support of efficiency wages (see following sections).

3.3 Endogeneity and the Wage-Supervision Relationship

As discussed in the previous section the main problem of empirical studies that try to identify if there is a wage-supervision intensity trade-off by standard estimation of wage equations with a measure of supervision being one of the explanatory variables, is the endogeneity of the supervision variable. One of the most effective ways to tackle the endogeneity problem is to exploit policy or other interventions that generate exogenous and independent variation in supervision intensity, as the studies discussed in the previous section that find valid instruments for the endogenous supervision variable (Wooldridge 2001, Cameron and Trivedi 2005). However, exploiting appropriate policy or other interventions and thus finding valid instruments is not an easy task and that is why, as suggested in the previous section there exist very few studies that manage to do so (Groshen and Krueger 1990, Krueger 1991, Rebitzer 1995).

Alternatively, when instrumental variables estimation is not possible, one may be able to reduce the endogeneity bias in the estimates of the wage-supervision relationship by using regression to control for confounding factors that are the likely source of endogeneity. Then it may be possible that one can use the observed sign of the estimate of the wage-supervision relationship produced by the regressions and any evidence on the direction

preference' where managers in company owned fast food restaurants make their lives easier by paying higher wages at the expense of the company. This has the same empirical implications as efficiency wages except that it is not efficient (Autor 2003).

of the omitted variable bias to infer the sign of the true relationship between wages and supervision.[76]

Standard econometric theory (Greene 2000) suggests that in the face of endogeneity, the direction of the OLS bias in the estimated coefficient of interest depends on the relationship between the main unobserved influences with the dependent and the endogenous variable respectively. In particular in the wage-supervision estimation, the direction of the endogeneity bias depends on the correlation of the main omitted variables with wages and supervision. However, one can argue that the nature of the main omitted factors and their relationship with wages and supervision depend on the rationale underlying the wage and supervision determination mechanism.

Thus, theory can be informative about the main unobserved factors that may cause a bias in the estimate of the wage-supervision relationship. This is why in the next sections we present the main theories of wage-supervision determination in the literature, as this is essential in our attempt to determine the main omitted factors and thus to predict the direction of the endogeneity bias.

In general, different theoretical models of wage/supervision determination point towards different omitted factors. Thus, including controls for the omitted factors suggested by a theoretical model of wage/supervision determination may be indicative of whether the model is relevant, as evidence that the inclusion of these controls in the regressions leads to a reduction in the bias of the coefficient of interest may provide support to the theoreti-

[76] For example if the regressions produce evidence of a wage-supervision trade-off, and there is also evidence that controlling for potential omitted factors leads to a more negative estimated coefficient of the effect of supervision intensity on wages, and thus the omitted variable bias is positive, then one can be quite confident that the sign of the true relationship between wages and supervision is negative, and thus there exists a wage-supervision trade-off.

cal model. Similarly if the inclusion of the controls suggested by a theoretical model does not lead to any change in the coefficient of interest, then this may be viewed as evidence that the data does not provide support to this model. Therefore, the latter approach may be a potential way for the econometrician to sort out alternative theoretical explanations of a negative or positive wage/supervision relationship.

Although the above method may provide a valid attempt to reduce the endogeneity bias of the coefficient of interest, to infer the sign of the true wage/supervision relationship and to sort out alternative theoretical explanations, it may not achieve identification of the true magnitude of the wage-supervision relationship. As discussed above for identification one needs exogenous and independent variation in the causing variable of interest (here supervision intensity), whereas our analysis exploits a different source of variation.

In particular, we exploit variation in supervision intensity generated by regional and industry variation in the skilled/unskilled wage differential which in turns produces variation in the cost of supervision across establishments. Other sources of variation we are exploiting may be regional differences in the unemployment rate, which according to the shirking model affect the probability of finding a job and thus affect the expected penalty of shirking and monitoring intensity.

Having said all the above, and provided that we also face the same problems hindering the estimation of the relationship between wages and supervision as previous studies in the field (Leonard 1987, Neal 1993, Brunello 1995, Ewing and Payne 1999), our main contribution is to investigate the relationship between wages and supervision using establishment level data from the UK, and thus provide some fresh evidence in the existing literature.

3.3.1 Efficiency Wages

Under a continuous effort version of the shirking model (Albrecht and Vroman 1998), employee's optimally chosen effort is a function of the wage and supervision intensity set by the employer, as well as other factors:

$$e = e(w, N/L, R), e_i > 0, e_{ii} < 0, i = w, N/L, R \ (1)$$

,where w is the wage, N/L is the ratio of supervisors to workers and R are all other factors that affect the intensity of effort chosen by employees.[77] By fixing effort to a certain level, the wage can be expressed as an implicit function of monitoring intensity as well as all other factors that affect effort. This wage function is given by:

$$w = f(N/L, e^*, R) \ (2)$$

, where e^* can be thought as the level of required effort by the firm.

[77] Note that these factors can be endogenous to the firm as for example other human resource practices (recruitment and motivation practices, etc.) or exogenous, as the discount rate, the worker's outside option, etc. as the shirking framework postulates.

Equation (2) is the equation of the contour of the effort function that defines the set of firm's isoeffort curves. It can be easily shown that isoeffort curves slope downwards in $(w, N/L)$ space, as the derivative of the wage with respect to monitoring intensity is given by:

$$\frac{dw}{d(N/L)} = -\frac{e_{N/L}}{e_w} < 0 \quad (3)$$

Provided the shape of the isoeffort curves and the fact that the representative firm will choose wages, supervision as well as other human resource practices to minimize the costs of a unit of labour that provides the target effort e^*, the optimal wage-supervision determination is illustrated in figure 3.1. The wage-supervision relationship illustrated in figure 3.1 is determined for given all other factors that affect the intensity of effort R (other personnel policy practices that affect effort such as screening and motivation mechanisms) in the firm, which further suggests that inability to observe and control for these factors will generate an upward bias in the relationship of interest (see also Rebitzer 1995).

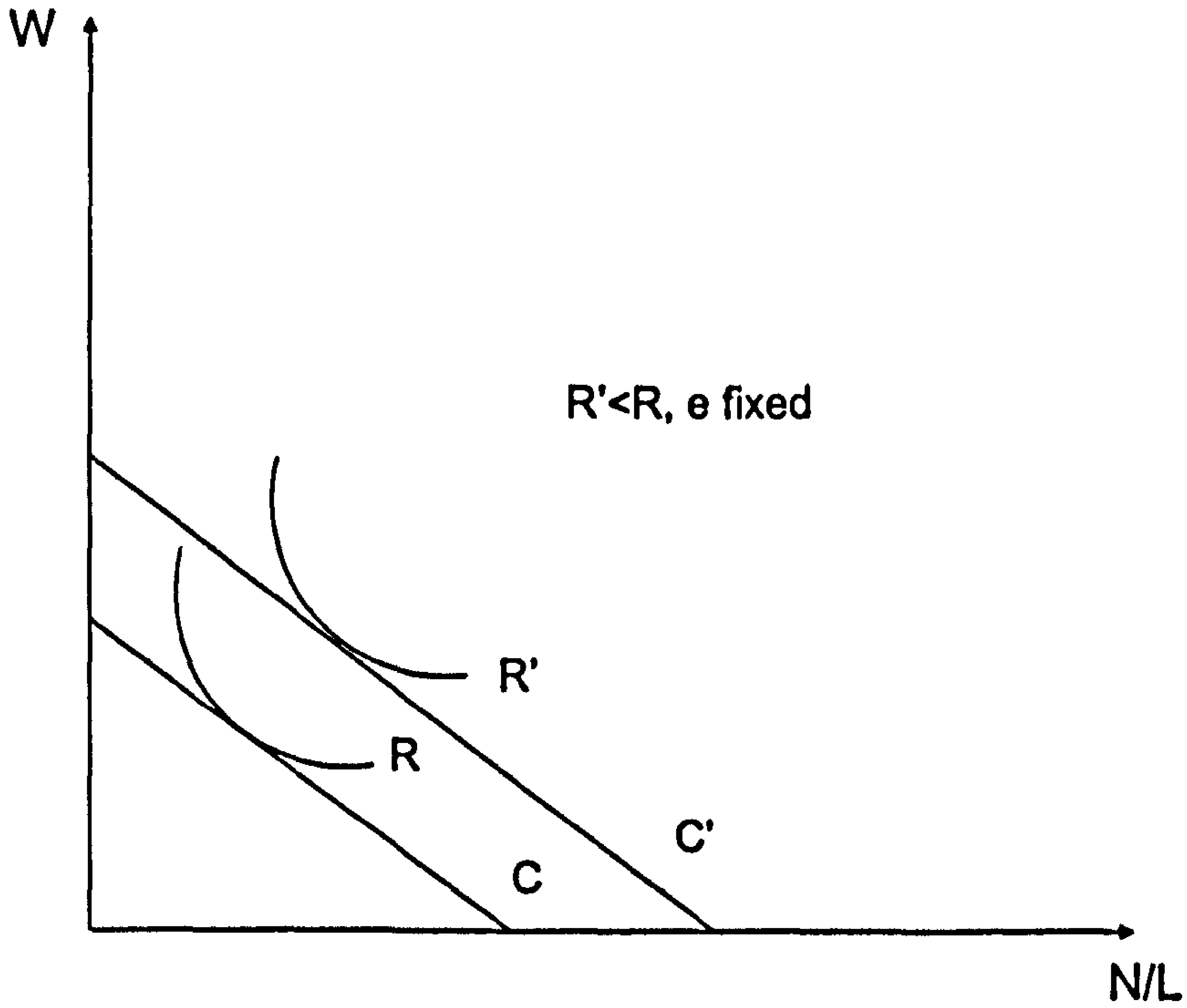

Figure 3.1: The effect of a change in effort determinants R in the optimal level of wages and supervision.

Note that according to the latter argument endogeneity may result because of unobserved factors that affect the choice of wage and supervision by firms with the same effort requirements. Moreover, firms may differ in terms of the effort target they set for many reasons[78] and therefore may require that their employees work harder and thus choose higher wages and supervision intensity.

[78] For example firms that consider product quality as a competitive advantage they will require employees to work harder and thus set higher wages and supervision (Kruse 1992). Similarly, businesses for which there is higher hazard on the job will require more caution and diligence by their employees which can be interpreted as higher effort which again can be achieved by more tight supervision and higher wages. Finally, in establishments where shirking costs are higher than elsewhere and if shirking is viewed as withheld and thus lower effort, it is optimal that managers use more stringent supervision and pay higher wages so that to ensure that effort is sufficiently high.

Thus, the above example illustrates that under the efficiency wages shirking rationale, the main omitted variables are required effort at the firm level or/and effort influencing variables, as for example other personnel and human resource practices and the endogeneity bias is expected to be positive and thus will mask any underlying wage-supervision trade-off that may be in operation.

This is not surprising as according to the shirking model the predicted negative relationship between wages and supervision is generated for everything else constant and in particular for given effort. Therefore, if the shirking model is true, controlling for effort differences as well as factors that may influence effort intensity across firms is important as it enables one to trace-out the wage-supervision trade-off along an isoeffort curve and if this is not done the result will be an upward bias in the relationship of interest.[79]

Another equivalent theoretical approach to the estimation of the wage-monitoring intensity relationship has been to start with a production function in efficient labour units, define the equation of the isoquants in $(w, N/L)$ space and use that to express the wage as an implicit function of monitoring intensity and other factors that affect output.

The production function is given by:

$$Q = Q[e(w, N/L) * L], Q_i > 0, Q_{ii} < 0, i = e * L, \quad (4)$$

[79] This argument is also demonstrated by the theoretical developed model in chapter 2, where after an exogenous increase in the wage because of the imposition of a binding minimum wage, and given that effort is continuous and is not held constant, employers increase monitoring intensity. In other words, employers who want to increase the effort level they will use higher wages and more intensive supervision.

If we hold output constant and provided that the functional form of the effort function allows to explicitly solve for wages, then the wage can be expressed by the following equation:

$$w = g(N/L, Q^{*}, L), \quad (5)$$

, where Q^{*} is the fixed level of output. It is easy to infer that the slope of the isoquants in $(w, N/L)$ space is negative.[80] Nevertheless, as in the case discussed above, and given that the true technological relationship has as postulated in equation (4), inability to control for output as well as employment[81] will shift the relationship between wages and supervision intensity resulting in upward biased estimates of the wage-supervision relationship.

This latter approach is used by Leonard (1987) who also suggests that there will be an upward bias in the estimate of interest in the case one does not control for output or other unobserved factors affecting output. Leonard uses employment to control for output and he implicitly suggests that the fact that he estimates wage equations for narrowly defined occupations may limit any unobserved heterogeneity across firms that may cause an upward bias. However, first of all employment may not be a good proxy for output (Groshen and Krueger 1990) and second there may still exist some unobserved heterogeneity in narrowly defined occupations across firms (for example different effort requirements for firm-specific reasons) that may explain why Leonard finds positive but insignificant effects of supervision on wages as a positive endogeneity bias may mask the wage-supervision trade-off. An

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[80] In particular it is exactly the same as the slope of the isoeffort curves, derived in the previous section.

[81] Even if one controls for output, differences in employment across firms will also generate differences in the effort required to produce a given output which again leads to an upward bias in the wage-supervision relationship.

alternative way to deal with the output bias when one follows this latter approach, could be to control for both effort and employment in order to identify any trade-off between wages and supervision along an isoquant.[82]

Even in the case that one controls for both output and employment, the trade-off between wages and supervision intensity may not be traced out along an isoquant, as different firms may have different effort and/or production technologies.[83] Given, that the latter argument is true this would mean that firms with more responsive effort, provided everything else is the same, will use both higher wages and more supervision, fact which generates an additional positive bias in the estimate of interest. Therefore, one needs not only to control for the level of effort but also for differences in the effort function across firms. The question of interest thus becomes also how one could determine potential ways to control for effort technology differences across firms.

Gordon (1994) conducted a cross-country analysis on variation of supervision intensity and suggested that wages and supervision are more effective in inducing motivation and

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[82] Controling for both effort and employment, given that the production function is as postulated by equation (4), is equivalent to controling for output, provided also that the effort and production technology is the same across firms. The usefulness of this approach is that it can be used to trace out the trade-off along an isoquant, without being necessary to explicitly control for output in the abscence of data on output and when data on effort and employment are available.

[83] Suppose that firms do not differ in the production technology but differ in the effort technology only, i.e. the effort function is differerent across firms or alternatively the responsiveness of effort in the wage and supervision is different for different firms. In this case if we keep output and employment fixed, given the same production technology in all firms we also control for effort level, because if all firms have the same output target and use the same amount of labour then they should also use the same level of effort to achieve the output target, given production technology is the same across firms. However, if firms differ in the effort technology, they will use a different mix of the wage and supervision intensity to achieve the same effort level, and it is quite intuitive why the more effort productive firms will use less of both wage and supervision to achieve the given effort level. This is an intuitive explanation of why we expect that differences in effort technology can be another source of a positive bias in the relationship between wages and supervision. We discuss a way to control for differences in effort technology in this section. Similarly, differences in production technology (assume effort technology the same across firms for simplicity), across firms can cause shifts and thus a positive bias in the relationship between wages and supervision.

effort in some countries, because of cross-national differences on the systems that govern labour relations. Particularly, Gordon (1994) points out that differences in labour management institutions and work norms may generate differences in the effectiveness of carrots and sticks as incentive devices.

The relevant literature, is using either continuous or categorical differences across economies in order to distinguish between 'corporatist' and 'competitive' systems or 'co-operative' and 'conflictual' regimes of labour relations respectively (Gordon 1990). One should expect heavy reliance of conflictual regimes on wages and supervision and lower reliance on these devices in cooperative regimes (Gordon 1994).

Gordon's factor analysis results suggested that out of many structural characteristics of labour relations systems two factors were those with the highest explanatory power. The first factor was labelled as an index of "income and job security", since high scores on this factor indicate low inter-industry wage dispersion, high government commitment to health services, an active government labour market policy, relatively high union-density, and reasonable protection against layoffs (including prenotification, maximum weeks of unemployment benefits, and mandatory severance benefits). The second factor was labeled as a measure of "worker bargaining power" since it loads most highly on the degree of co-ordination of union bargaining, mandatory prenotification and union density. Based on the literature, we would expect economic systems with higher indices of "income and job security" and "worker bargaining power" to feature relatively more "cooperative" where we should expect lower responsiveness of effort on the carrot (the wage) and the stick (supervision intensity). Thus, the idea is to try to control for firms' features or characteristics that may indicate whether labour relations is of a "conflictual" or of a "cooperative" type (see the data section).

As in the case of Leonard (1987) the above discussion regarding the direction of the endogeneity bias casts doubt on the findings of some of the most cited attempts to estimate the relationship between wages and supervision and may also explain why these studies rendered inconclusive (Fitzroy and Kraft, 1986, Neal 1993, Brunello 1995).

One of the main objectives of the above analysis is to emphasise that the 'shirking' and 'gift-exchange' models are predicting a wage-supervision trade-off, ceteris paribus. Therefore, one cannot dismiss efficiency wages in favour of alternative theories[84] if he/she cannot find a negative relationship between wages and supervision, unless firstly he/she explicitly controls for all required factors.[85]

This is something that seems not to be explicitly suggested in many studies in the field. An exception is the fast-food industry study presented by Krueger (1991), who argues that fast food jobs are highly homogeneous in skills and performance requirements and thus

84 Theories that are consistent with a positive relationship between wages and supervision are: a) equalizing differences models (Rosen 1986), where supervision is considered by employees as a 'bad' working condition and thus, ceteris paribus, employees should be paid a compensating wage-differential, when they are supervised more stringently. b) Effort discipline (Bowles 1985, Bowles and Boyer 1988) models, where the wage and supervision are viewed as complements in inducing effort, as an increase in the wage cannot induce effort, if it is not accompanied by supervision increases, because dismissal threats are not credible unless there is sufficient monitoring. c) Product differentiation theories as firms that are more concerned about the quality of their product will pay higher wages and supervise employees more stringently (Kruse 1992), d) Finally, occupational differences may also explain a positive relationship between wages and supervision, because in some occupations employees are paid higher wages and are supervised more tightly (this happens usually when there is high-risk in terms of safety, as for example in the Petrochemical industry (Rebitzer 1995)).

85 In general, the efficiency wage effect can work through inreased motivation but also through improved quality of the workforce. Therefore, for the econometrician to be able to trace-out the trade-off between wages and supervision, he/she must control for both employees performance and quality differences. This argument is also demonstrated in Georgiadis (2001), where a positive relationship between wages and supervision is the case, in a shirking model with heterogeneous workers and/or continuous effort, as an increase in the wage enables the firm to improve the quality of the workforce and/or increase effort on the job. Therefore it is also important to control also for employees heterogeneity, when estimating the wage-supervision relationship.

there is limited scope for unobserved heterogeneity across fast food outlets that could bias the estimate of interest.

Additionally, Groshen and Krueger (1990), implicitly assume that given that they examine the wage-supervision relationship for narrowly defined occupations, effort requirements or other related unobserved factors should not vary much for the same occupation across hospitals. However, they do find a significant hospital specific effect on wages, which could be explained also by differences in effort requirements across hospitals. If differences in effort requirements is a valid explanation for the hospital specific effect on wages, and if there are valid efficiency wages considerations, then we should expect that there would be also a positive hospital specific effect on supervision. In fact this effect is not documented by Groshen and Krueger but this is not because differences in the intensity of effort is not a potential explanation, but because of minimum supervision intensity requirements which are imposed by state and federal government across areas, and constrain optimal adjustments of supervision intensity.

3.3.2 Employees Quality Sorting

Another theoretical explanation of a negative relationship between wages and supervision is provided by the so-called "sorting by ability" model which is based on the assumption that more able employees that are paid higher wages could be left more autonomy on the job as they need less guidance and coordination. Therefore, under this theory, profit maximizing employers will increase the wage up to the point where the improvement in employees' quality will be such that the increase in wage costs is exactly offset by a fall in supervision costs (Groshen and Krueger 1990). Thus, this model is not only consistent with a wage-supervision trade-off but also predicts that in equilibrium wage costs should be offset by supervision costs which is exactly what is predicted by the shirking model of efficiency wages.

Therefore, under this theoretical framework, unobserved differences in employees' quality across firms or establishments will lead to a negative bias in the wage-supervision relationship. Therefore, unless one finds a valid instrument or effectively controls for employees' ability it is hard to conclude that any evidence on a wage-supervision trade-off provides evidence in support of efficiency wages. However, note that if the true relationship between wages and supervision is as the "sorting by ability" model postulates, then if one controls for employees' quality then the wage supervision relationship is expected to be positive.[86]

The close observational equivalence between the "sorting by ability" and efficiency wages theories with respect to the wage-supervision trade-off not only causes problems in sorting out the two models in the light of evidence supporting a trade-off but has a result the problem to persist even if one shows that wage increases pay for themselves by lower supervision costs, which is an extra condition used to test whether employers pay efficiency wages (Levine 1992, Rebitzer 1995). The only difference between the two models seems to

86 In the 'sorting by ability' model 'isoability' curves slope upwards in the wage-monitoring intensity space because an increase in the wage must be followed by an increase in supervision intensity in order for ability to be constant. This is because on the one hand an increase in the wage increases average ability of the workforce because enables employers to employ more able workers, but on the other hand an increase in supervision intensity will enable the employer to substitute less able for more able employees, to keep average employees' quality constant, as less able workers need to be supervised more stringently. If one does not control for differences in employees quality/ability across establishments and provided that the sorting by ability model is true, this will generate shifts in the isoability curves across establishments which will have as a result a negative relationship between wages and supervision to be traced out.

be the fact that for efficiency wages, wages and supervision are effort/productivity eliciting devices and the trade-off is predicted ceteris paribus, whereas in the "sorting by ability" model, wages and supervision interact through any quality adjustments in the workforce, and the trade-off is the case for varying employees' ability across firms.[87]

3.3.3 Unions

In this subsection we offer another but novel explanation of the wage-supervision trade-off, based on the premise that wages and supervision are the result of firm-union collective bargaining arrangements.

In particular, the analysis is based on the theoretical framework presented in chapter 2 with a suitable extension to include union-firm bargaining over effort. In the theoretical model of chapter 2, the firm's objective is to maximise profits subject to the non-shirking condition which expresses average effort (the non-shirking condition can also express the proportion of non-shirkers, under this framework) as a function of the wage and supervision intensity as well as other factors.

In the absence of unions, the firm's problem is:

$$\begin{aligned}\max_{w,N,L} \Pi &= f(\theta * L) - wL - cN \ (6) \\ s.t\ \theta &= \theta(w, N/L, R) \ (7)\end{aligned}$$

[87] The theoretical model of chapter 2 assumes heterogeneous employees in terms of their innate inclination to shirk and predicts that an increase in the wage will have as an effect that the marginal worker will have higher disutility of effort compared to the situation before the wage increase. Moreover, the wage increase will affect the distribution of characteristic between workers and shirkers and increase the average inclination to shirk of workers compared to that of shirkers. Therefore the wage-supervision trade-off is predicted under this framework for given average effort in the firm (or proportion of non-shirkers) and average "quality"/characteristic of workers.

, where θ is the average effort which depends on the wage w, monitoring intensity as captured by the supervisor to staff ratio N/L and other exogenous parameters that affect workers inclination to shirk R (worker's outside option, discount rate, quit rate etc.). For expositional purposes and for simplicity we will assume that the firm's objective is to maximise profits per employee. Under the simplified assumption of constant returns to scale in efficient labour units and after substituting (7) to (6) the firm's problem becomes:

$$\max_{w,N/L} \pi = f[\theta(w, N/L)] - w - c\frac{N}{L} \quad (8)$$

, which implies that firm's problem can be reduced in choosing the wage and monitoring intensity and in this way average effort to maximise profits per worker π.

On the other hand, we will assume that union's objective is to maximise the average utility of unionised workers that are employed by the firm. Therefore, union's utility or objective function can be expressed by the following equation:

$$V = w - \theta(w, N/L) \quad (9)$$

, where w is the wage of the average employee in the firm, which is equal to the wage set by the firm, as in the model developed in chapter 2 all workers are paid the same wage and θ is the average effort in the firm. Therefore, given the objective functions of both parties and provided also that both parties have a zero fallback, the solution of the bargaining game[88] will be the solution of the following maximisation problem:

[88] This is the standard alternating offer bargaining game over the division of a pie between two parties, under full information on both sides about the payoffs to the other side.

$$\max_{w,N/L} \Omega = V^{\alpha} * \pi^{\beta} \ (10)$$

, where Ω is known as the Nash maximand (Nash 1950, 1953) and α, β are parameters that capture union's and firm's bargaining power respectively (usually dependent on the two parties discount rates and outside options).

As it may be the case that some times unions bargain over manning ratios, for example the level at which machines or offices are manned or sometimes in trains or ships the crew size, or in general how hard workers have to work, it is reasonable to assume that the union and the firm bargain over effort,[89] which is an approach often adopted also by others (Layard Nickell and Jackman 1991).

For our purpose, which is to predict any effects that may arise from bargaining between unions and employers, under efficiency wages considerations, on the wage-supervision intensity relationship, it is sufficient to provide a diagrammatic illustration of the bargaining solution (see figure 3.2). Therefore, given that the union and the firm bargain over average effort which in turn is determined by the level of the wage and monitoring intensity, the bargaining solution can be illustrated in the $(w, N/L)$ space. It is easy to show that the contours of the firm's objective function are elliptic, as the indifference curves are arising from satiated preferences. Moreover, as we explained previously, because of the wage-supervision intensity trade-off, for given effort, we expect that the average isoeffort curves slope downwards in $(w, N/L)$ space.

[89] The fact that unions bargain over wages and supervision intensity which determine the level of effort also imply that unions implicitly bargain over the determinaton of effort.

Finally, it can be shown that union's indifference curves slope upwards in $(w, N/L)$ space,[90] which is derived from union's objective function, that postulates that unions "like" wages and "dislike" supervision.

As, it is shown in figure 3.2,[91] if there is an increase in the union's bargaining power, we expect that the outcome of the bargaining process will involve higher wage and lower supervision intensity and probably lower average effort, as the equilibrium shifts in a higher union indifference curve. This result implies that differences in union's bargaining power across unionised firms may cause a negative bias in the wage-supervision intensity, which may be another explanation of a negative relationship between wages and supervision.[92]

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[90] The slope of union's indifference curves in $(w, N/L)$ space is : $\frac{dw}{dN/L} = -\frac{V_{N/L}}{V_w} = -\frac{-\theta_{N/L}}{1-\theta_w}$, which is positive as $\theta_{N/L}$ is positive as effort is increasing in supervision intensity, and it can be also shown that $\theta_w < 1$, by chapter 2.

[91] We use P to denote the firm's eliptic isoprofit curves, u for unions indifferences curves and e for isoeffort curves in the (W,N/L) space.

[92] This prediction holds, under the assumption that union's objective function is such that unions "like" wages and "dislike" supervision.

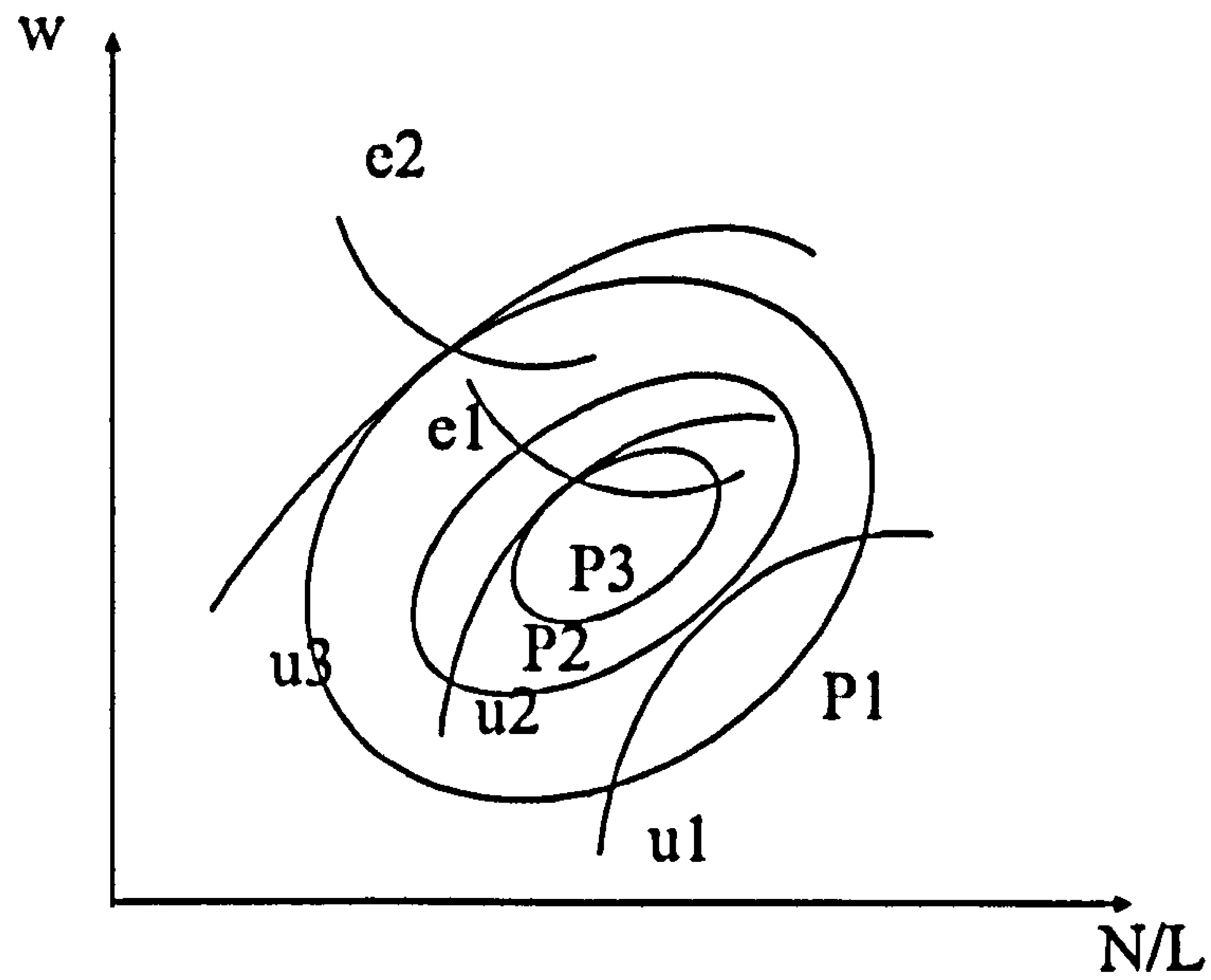

Figure 3.2: The determination of the wage and supervision by union-firm bargaining and the 'union-power' bias.

Thus, under this theoretical framework the main variable is the union's bargaining power which if omitted from the wage specification the result will be a downward bias in the wage-supervision relationship. This result may cast doubt on the findings of empirical studies that suggested that their evidence of a wage-supervision trade-off are made more compelling by the fact that any omitted variable bias is expected to be positive (Leonard 1987, Ewing and Payne 1999).

In conclusion, we show that under reasonable assumptions, union-firm bargaining may offer another explanation, of the wage-supervision trade-off, which is something that should be also taken seriously in mind and hasn't been addressed by any previous study in the topic.

3.3.4 Equalizing Differences and Workers Preferences over Supervision

In the previous section we show how union's preferences over wages and supervision may explain the wage-supervision trade-off when unions bargain over wages and/or working conditions (supervision and effort intensity).

The theory of equalizing differences explains observed wage-dispersion across firms and establishments by postulating that workers must receive a wage-differential in order to be compensated for differential working conditions across firms. In our case this simply implies that if supervision intensity is viewed by workers as an important feature of working conditions in the establishment, then workers' preferences over supervision intensity will determine the level and differences in compensation across establishments.

If for example workers "dislike" supervision because they "dislike" effort and because in the presence of supervision they have to supply more effort than in the absence of supervision (Groshen and Krueger 1990) then employees working in firms with higher supervision should receive higher wages, ceteris paribus. According to Groshen and Krueger (1990) another reason why employees 'dislike' monitoring is because they may consider it as a disagreeable intrusion in their privacy and independence. Therefore, if supervision is viewed by employees simply as a bad working condition and not as a motivation device, then a positive relationship between wages and supervision is the case.

On the other hand if workers "like" supervision because for example tight supervision enables them to achieve job goals (Groshen and Krueger 1990) then a negative wage differential must be paid to employees in establishments where supervision is more intensive. Therefore another explanation of the wage-supervision trade-off can be provided by equalizing differences theory, under the assumption that supervision is a 'good' working condition.

The above discussion is based on homogeneous employees' preferences over supervision. Under the case where employees' have heterogeneous preferences over supervision intensity then the sign of the wage differential paid by employers depends on the preferences of the marginal worker (Groshen and Krueger 1990).[93] All in all, the main point of this section is that another interpretation of the wage-supervision trade-off may be provided by equalizing differences theory under unobserved employees preferences, when employees 'like' supervision.

3.3.5 Principal-Agent Theories

The fact that there exist many different theoretical explanations[94] of the wage-supervision trade-off suggests that even if one provides consistent evidence that support the wage-supervision trade-off doesn't necessarily mean that this evidence provide also support to efficiency wages. However, even in the case where all alternative to efficiency wages explanations of the wage-supervision trade-off are ruled out, the findings should be still interpreted with caution. Provided that all alternative explanations have been dismissed the

[93] If one assumes that all employees either 'like' or 'dislike' supervision but the extent they do that varies across employees, then the sign of the wage differential depends on the nature of preferences of employees over supervision, whereas the magnitude of any wage differential depends on the extent the marginal worker 'likes'or 'dislikes' supervision.

[94] Another explanation of the wage-supervision trade-off may be provided by unobserved occupational differences across firms, that lead to lower wages and higher supervision (Goldin 1986, Kruse 1992). By unobserved occupational differences we mean any occupational differences that are not due to differences in effort requirements or/and employees' quality across establishments, which are expected to be picked up by any employees' quality and effort controls.

most plausible interpretation of a negative wage-supervision relationship should be as supporting one of the tenets of efficiency wages that wages and supervision are substitutes in inducing employee effort and motivation.

Even in this case, this finding is not sufficient to provide support to efficiency wages as the trade-off between wages and supervision arising from agency problems is also predicted by agency theories many of which do not share the efficiency wages property.[95]

Therefore testing if there is a wage-supervision trade-off and showing that the trade-off arises because of agency problems is equivalent as testing a necessary but not sufficient condition for efficiency wages as this provides only indirect evidence of effects of wages on employees' productivity. The latter is a fundamental assumption of efficiency wages but another fundamental feature or implication of efficiency wages is that employers find it optimal to set the wage unilaterally above the market clearing wage in order to maximize profits.

Therefore, in order to test for efficiency wages one needs to show firstly that a wage-supervision trade-off exists and then that the trade-off is consistent with a principal-agent wage and not any alternative rationale. The latter test will reveal whether wages affect workers' productive behaviour, which if holds then one needs also to test whether wages are set optimally to elicit the required productive behaviour by employees by testing whether the costs from wage increases are offset by a fall in supervision costs.

[95] Efficiency wages should be seen as a special case of principal-agent theories of motivation, where there is a lower bound in the compensation the agent can receive under any state. In other words the distinguishing feature of efficiency wages is that wages are set above the market clearing wage.

3.4 Other Considerations

3.4.1 Substitution of Supervisors for Workers

Furthermore, on the endogeneity problem related to the supervisor-staff ratio, Groshen and Krueger (1990), using a standard minimisation argument and a standard Cobb-Douglas production function depending on supervisory and labour inputs, they show that an increase in the wage will increase the supervisor/supervisee ratio, in any case where the production technology allows for a non-zero marginal rate of substitution between supervision and employment, because of substitution of supervisors for workers,[96] leading to a positive bias in the estimate of the relationship between wage and supervision. It is very intuitive why this is the case under Groshen and Krueger's chosen setting as the wage is exogenous and does not affect productivity, and that is why an increase in the wage renders labour input relatively more cheap than the supervisory input leading to substitution of supervisors for workers.

Nevertheless, if we instead assume that the underlying technology is as postulated in (4), where output depends on efficient labour units, and if we assume that the wage is given because for example of a binding minimum wage in the labour market, the same minimisation argument can be used to show that, it may be also the case, that an exogenous increase in the wage, may also decrease the supervisor to staff ratio, depending on the responsive-

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[96] This argument is based on the fact that the production function is of the standard neoclassical type, with supervision and labour the only direct and non-inferior inputs to production, and with given input prices to the firm. Under this framework, an exogenous increase in the wage tilts the isocost so that the tangency with the isoquant of the target output is at a point at which more supervisory input is used relative to labour input.

ness of the marginal product of labour relative to the marginal product of supervision w.r.t the wage).[97]

If we assume that the production technology is given by equation (4), then cost minimisation implies that

$$\frac{MPL}{MPN} = \frac{w}{c}, \ (11)$$

,where MPL and MPN are the marginal product of employment and supervision and w and c are the price of labour and supervision respectively, which we assume that they are given. Under this case, both the MPL and MPN are dependent on the wage. Suppose now that the wage is given by a minimum wage (see chapter 2).[98] An increase in the wage, has an ambiguous effect on the supervisor/supervisee ratio, as the change depends on the relative responsiveness of MPL and MPN to the wage increase.

The main aim of this section is to show that the prediction of Groshen and Krueger (1990) hinges heavily on the particular theoretical setting they use at which the wage is exogenous, whereas under efficiency wages as well in empirical studies of the wage-supervision trade-off the wage is treated as endogenous.

Moreover, we show that, under efficiency wages and in the special case the wage is increased exogenously the effect on the supervisor/supervisee is ambiguous. Finally, it is

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[97] In Georgiadis (2001) the effect of the wage on the marginal product of both labour and supervision is ambiguous, but it can be shown that they are moving always in the same direction. In the case that both marginal products increase, it is shown that the changes are such that the supervisor/supervisee relative use in production must be increased. In the case, where both marginal products are decreasing then the change in the supervisor-to staff ratio depends on the relative responsiveness of the marginal product of labour and supervision w.r.t the wage. However, it is shown that other restrictions is the reason why the ratio of supervisor to staff increases even under this latter case.

[98] Otherwise this argument cannot be applied as the wage is endogenous in efficiency wages models.

important also to point out that under the efficiency wage framework, even if the production function allows for substitution of supervisors for workers an increase in the wage will result in a fall in the ratio of supervisors to workers, if effort is held constant. This argument suggests that, given that the production function is as postulated by (4), controlling for effort will prevent any substitution effect to mask an underlying wage-supervision trade-off.

3.4.2 Measurement Error

Other problems associated with the trade-off are measurement error problems related to the use of supervisor to staff ratio. In particular, Rebitzer (1995) argues that supervisors do not have a solely monitoring responsibility on the job and there are supervisory workers that do not have any monitoring role at all and thus the supervising to supervised employees ratio overstates the intensity of monitoring.

Actually, we believe that this is mainly a problem of definition and even if monitoring is not the only task of supervisory employees who may contribute explicitly to production, it remains their main task and thus the supervisor to staff ratio is expected to be highly correlated with the extend of monitoring (Odiorne 1963, Gordon 1990 and 1994).[99]

Finally, Brunello (1995) considered quantity of supervision, represented by the supervisor to staff ratio, as only one dimension of monitoring, and suggested that quality of supervision should be also taken into account. After finding that the inclusion of quality in

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[99] Gordon (1990) defines supervisory inputs as those wage-and-salary employees of a firm with considerable if not primary responsibility for monitoring the labor effort of those below them in the firm's hierarchy, especially including the labour effort of production workers.

wage equations abates the wage-supervision trade-off concludes that measurement error in the main variables should stressed out as another major problem that hinders the identification of the relationship of interest. However, in the case that one finds a negative estimate of the wage-supervision relationship, and provided that measurement error attenuates the estimate of interest, the trade-off becomes more compelling (see estimation section).

3.5 The Data

The data set we used is drawn from the British Workplace Industrial Relations Survey (WIRS) of 1990. This establishment-level survey provides information on a sample of more than two thousands establishments, with 25 or more employees, from almost all sectors of the UK economy. Except of the fact the data are not drawn from a specific sector and thus any results can be generalised, another strength of the WIRS data is that it includes information on supervision, wages and other determinants of wages that are important for our analysis.

In particular, the workforce is decomposed into manual and non-manual employees, where the manual workers category is further decomposed by skill (unskilled, semi-skilled and skilled) and the non-manual is decomposed by occupation (managers, technicians, supervisors/foremen etc.). In the subcategory of supervisors/foremen are included all supervisors/foremen of manual workers and administrative/clerical workers with supervisory responsibilities. This category excludes all non-manual workers with other responsibilities and some supervisory responsibilities as well, fact which suggests that includes all non-manual workers with primary and main duties the supervision of manual/clerical workforce. Therefore, the monitoring intensity proxy we construct is the ratio of supervisors/ foremen to the total number of manual and clerical workers.[100]

The focus of attention in this paper will be on the determination of wages of the three different skill categories of manual workers. Note that even though WIRS is a survey of 2061 establishments, wages are reported for the majority gender in each skill group only in establishments where there are more than five employees in skill group.[101]

Another important strength of WIRS for the purpose of our analysis is that it offers information on potential controls for workers' effort. Particularly in the management questionnaire includes information on the ratio of all other costs share to labour costs share in total costs which is often considered as a good proxy of the intensity at which employees may work with capital equipment or machines (Layard, Jackman and Nickell 1991) and therefore a good proxy for the extent of shirking costs as smaller relative labour share is likely to be associated with higher shirking costs,[102] because this may imply that workers may work with more expensive equipment than establishments with larger relative labour share (Katz 1986).

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[100] We believe that the WIRS definition of the supervisor /foremen category limits concerns for the standard measurement error problem, where the supervisor to staff ratio is expected to overestimate the extent of monitoring, as foremen of manual workers and clerical workers with supervisory responsibilities have as a main task the monitoring and inspection of manual and clerical employees. Thus, given the WIRS 1990 definitions, the supervisors to staff ratio in our case may not systematically overestimate monitoring intensity in the establishment.

[101] Considering also missing observations because of non-response even in establishments with more than five employees in skill group or because of responses of "don't know" or "non applicability" of the particular question in some establishments, the remaining observations on unskilled, semi-skilled and skilled median wages are 1232, 990 and 1105 respectively.

[102] Unobserved differences in shirking costs are expected to be the source of a positive bias in the estimate of the elasticity of the wage with respect to supervision (Leonard 1987, Neal 1993).

On the other hand another proxy for effort seems to be provided by answers to questions on the intensity of work in the establishment surveyed, relative to other establishments in the same industry.

The WIRS 90 includes detailed information on unions and collective bargaining arrangements as well as other features of labour and industrial relations, which are essential in order to control for 'effort technology' and for differences in union bargaining power across establishments. In order to measure differences in industrial relations regimes that determine the responsiveness of employees effort in the wage and supervision and thus some features of effort technology across establishments we use information of provision of extra employees' benefits as sick pay over and above statutory requirements, free or subsidized food or meals, occupational pension and a standard working week of less than 36 hours. Additionally, we use also the proportion of employees dismissed for reasons other than redundancy and the proportion of employees received disciplinary sanctions. We expect that these variables will pick up some of the degree of conflict or cooperation that characterises labour-management relations in the establishment and thus any differences in the responsiveness of effort in motivation devices, as the wage and supervision.

Moreover, union power bias considerations, as suggested by the theoretical analysis in one of the previous sections may be particularly valid in this case because a significant proportion of establishments in WIRS 90 are unionised but also because in an important fraction of unionised establishments, unions negotiate not only over pay and physical working conditions but also over manning and staffing levels, recruitment, level of redundancy payments and other issues.[103] In order to control for differences in union bargaining power across establishments we use a dummy for whether or not a recognised union negotiates also over staffing and manning levels and other issues for manual workers but also a dummy for the existence of a closed shop.

The justification of the choice of the closed shop dummy as a good measure of differences in bargaining power is that union bargaining strength comes in large part from the strike threat. A union with a closed shop arrangement at a particular establishment will be in a stronger position to call a strike than one without. A union's bargaining strength is reduced when there is a non-union pool of suitably qualified labour that an employer can hire from to cut costs. The likelihood of this is reduced and thus the bargaining strength of the union increased, where there is a closed shop (Stewart 1987, Stewart 1990, Machin, Stewart and Van Reenen 1993).

Our previous analysis also suggested that if the prediction of the shirking model that wages and supervision are substitutes in motivating employees then a positive bias is predicted to occur in the estimate of the relationship of interest because of omission of effort intensity controls, as well as other human resource practices that affect effort and thus the choice of wages and supervision by personnel managers. The information included in WIRS allows us also to construct controls for other motivation devices that may be used in establishments and thus to verify the direction of the bias (if any) generated by omitting these controls. In particular, WIRS 90 includes detailed information on merit pay across skill groups and whether appraisal of employees is used for promotions or pay rises.

[103] Strikingly in 1047 out of 1236 unionised establishments there exist a recognised union that negotiates not only over pay but also on staffing and manning levels and other issues as suggested above.

In our analysis that follows we also try to provide an alternative test of the wage-supervision trade-off based on the conjecture that if there exist a wage-supervision trade-off in operation, then it is likely to be more pronounced for firms in the private sector and non-unionised firms, as these firms are expected to be in a better position to take advantage of the trade-off because of cost minimizing behaviour and greater flexibility in adjusting pay and staff levels compared to unionised or/and public sector firms. This is the reason why we also restrict estimation in this particular subsample of firms, where the trade-off is expected to be more pronounced.

The focus on the sample of non-unionised and privately owned establishments becomes even more appealing if one also considers that the essence of efficiency wages is the unilateral (no other forces, as unions are expected to affect wage-determination) and optimal (profit maximising and cost minimising behaviour is more likely to be the case in the private sector) setting of wages above the market-clearing wage from employers.

An offsetting weakness of the WIRS 1990 is the lack of detailed information on employees quality and characteristics, as well as detailed occupation information. However, we believe that the fact that in our study we address the problem separately for the wages of unskilled, semi-skilled and skilled manual workers should significantly reduce heterogeneity in worker quality or any unobserved variation due to occupational differences. Finally, the use of other controls that may capture the average human capital and technology in the establishment also abates this problem.

3.6 Estimation

3.6.1 Unskilled

Tables 3.1 to 3.3 summarise the main estimation results of semi-log wage equations for unskilled manual workers (see tables section at the end). Estimated specifications are of the form of equation (2), which is the equation of the isoeffort curve produced by the production function.

The dependent variable is the natural logarithm of the median weekly wage of the majority gender in the unskilled manual group[104] and the main explanatory variables, except the supervisors to staff ratio, are some of the establishment characteristics (size, industry affiliation, union recognition, ownership, etc.) that according to the literature (Groshen 1991, Stewart 1987, 1990) are the main determinants of inter-establishments wage differentials.

In table 3.1 we present estimation results for the full sample of establishments in WIRS 1990. Results from the first estimated specification suggest a positive but insignificant relationship between wages and the supervisor to staff ratio, and a positive wage-differential for unskilled manual workers in establishments that have more employees (not reported in table 3.1),[105] but also a positive wage differential for employees in establishments that are in manufacturing and in trading (private) sector as well as in establishments where there is a recognised union.[106]

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[104] The wage data are grouped into intervals and that is why wage equations are estimated by maximum likelihood which, under broad conditions, produces consistent, asymptotically normal and asymptotically efficient estimates of the parameters of interest (Stewart 1983).

[105] The establishment size dummies are positive, monotonically increasing and jointly significant but individually insignificant.

[106] Note that coefficients in models with grouped dependent variable are interpreted in the standard OLS

Specification (2) includes also controls for the decomposition of unskilled manual workforce in terms of gender and the decomposition of total manual workforce in terms of part-time status. Estimates indicate that unskilled manual workers are paid on average lower wages in establishments with higher proportion of female employees in the unskilled manual group, but the same is not the case for establishments with higher proportion of part time manual workers.[107]

In general controls for workforce characteristics may pick up differences in observed average quality of unskilled manual employees across establishments, and thus may provide an indication of any unobserved employees' quality/ability bias, provided that observed workers' quality characteristics are correlated with unobserved. Under the latter assumption, the inclusion of employees' quality controls suggests that any unobserved ability or 'employee quality' bias seems to be quite sizeable in magnitude, although the wage data are from a relatively homogeneous group of workers across establishments. Moreover, the change in the estimate of interest generated by the inclusion of manual workforce' characteristics suggests that any unobserved employees' quality bias is positive, in contrast to the 'sorting by ability' model that predicts a negative unobserved ability bias in the estimated coefficient of monitoring intensity.[108]

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fashion (Stewart 1983).

[107] The estimated coefficient of the proportion of part-time employees in the manual employees group is in the fringe of statistical significance.

[108] Stewart (1983) showed that maximum likelihood estimators (MLEs) of the parameters of a linear model, with a normal homoscedastic error, where the dependent variable is grouped, are equivalent to OLS estimators of the parameters of the model produced by the regression of the conditional mean of the dependent variable on the exogenous variables, where conditioning is not only on exogenous variables but also on the interval in which the true value of the dependent variable is included. The conditional mean is calculated based on an initial random guess of values of estimated parameters and an iterated procedure is used up to convergence in order to determine the optimal estimated parameters. Therefore, because of the OLS equivalence of the MLE for the interval regression model, the standard OLS omitted variable bias formula can be used in order

Specification (3) includes dummies for the ratio of all other costs share to labour costs share in total costs which are expected to pick up differences in effort intensity or shirking costs across establishments, as discussed in the previous section. The inclusion of the effort intensity (or shirking costs) proxies in specification (3) results in a downward change in the estimated coefficient of the supervisor to staff ratio and seems to support our prediction that unobserved differences in the intensity of effort across establishments cause an upward bias in the estimate of the wage-supervision relationship that masks any wage-supervision trade-off. Moreover, the same doesn't seem to be the case when dummies for the intensity of work in the establishment, as reported by manual workers representative in the workplace, are also included in the estimated specification (see specification (4) in table 3.1).[109]

Similarly, we find that the inclusion of controls for differences in 'effort technology' and of controls for the use of other personnel policies that aim to motivate employees does not cause a significant change in the coefficient of interest, as implied by estimation results for specification (5) and (6) of table 3.1.[110]

Therefore, as the pattern of change in the coefficient of supervisor to staff ratio doesn't seem to indicate any sign of support of a wage-supervision trade-off in the case

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to predict the direction of any omitted variable bias.

[109] A Hausman specification test is used throughout in order to test whether the change in the coefficient of interest generated by the inclusion of extra and relevant to the theory controls is significant. In other words, the Hausman test is used to check whether unobserved variation of factors that according to the 'shirking' model are expected to be correlated with wages and supervision, may cause a bias in the estimated coefficient of supervision intensity. Results of the Hausman test suggest that although the inclusion of relative costs ratio dummies generate a significant downward change in the coefficient of monitoring intensity, the same is not the case with subjective work intensity dummies.

[110] Note also, that although the findings indicate an increase in the coefficient of monitoring intensity, when we control for union bargaining power, a Hausman test suggests that the there is no significant and systematic negative 'union' bias, as predicted by the theoretical model presented in one of the previous sections.

of the full–sample of establishments (except of some evidence in favour of an upward effort intensity bias), as suggested by our analysis in the previous sections, we next turn to present estimation results from private (trading) sector establishments.

The focus to the private sector is justified by the discussion in the previous section which suggests that if the wage-supervision trade-off is a result of cost-minimising behaviour of firms, as implied by the shirking but also by the 'sorting by ability' model, then a wage-supervision trade-off is expected to be more pronounced in private sector establishments which are more likely to exhibit a cost-minimising behaviour compared to establishments in the public sector.

Estimation results for the trading sector are presented in table 3.2. In this case the pattern of change in the coefficient of interest across different specifications which gradually include controls for workforce characteristics, effort intensity, effort technology as well as controls for practices that aim in motivating manual employees seems consistent with a wage-supervision trade-off, although the wage-supervision relationship changes from positive and insignificant to negative and insignificant.

In particular, we fail to find any evidence of a negative bias due to unobserved workers' quality as it would be the case if the 'sorting by ability' model would be true, because again the inclusion of controls for manual workforce characteristics causes a significant decrease in the magnitude of the coefficient of interest.

Moreover, controlling for effort intensity turns the coefficient of supervision intensity from positive to negative but the coefficient remains insignificant. This finding is consistent with one of the points of the analysis of the previous sections, that if wages and supervision intensity are substitutes in eliciting effort from employees, then differences in the intensity of work across establishments is expected to generate an upward bias which may mask a negative relationship between wages and supervision.

Additionally, the inclusion of 'effort technology' and 'other motivation devices' controls seems to provide further support to the hypothesis that if wages and supervision are effort extracting devices, then a positive endogeneity bias will be the result of unobserved variation in factors that are correlated with the intensity and the responsiveness of employees' effort.

Effort technology controls include a dummy for employees' benefits in the establishment as sick pay, free or subsidized meals and an occupational pension over the standard employee pension, as well as the proportion of employees dismissed or sanctioned over the last year for disciplinary reasons. These variables are expected to pick up how 'conflictual' or 'cooperative' are labour relations regimes across establishments, which in turn according to Gordon (1990, 1994) may indicate how responsive is employees' effort in motivation devices as supervision and wages.

The wage-supervision trade-off increases in magnitude when 'effort technology' controls are included, as indicated in specification (5) but the trade-off is statistically insignificant. This finding may support our prediction that if wages and supervision are effort regulating devices, then excluding factors that determine the nature of labour relations across establishments and thus the responsiveness of employees' effort to personnel motivation practices, will cause an upward bias in the coefficient of supervision, as we would expect that in establishments with more 'conflictual' labour relations effort will be more responsive in both wages and supervision and thus these establishments will tend to pay higher wages and supervise their employees more stringently.

As suggested in the analysis of the previous sections, the endogeneity bias of the wage-supervision relationship is expected to be positive if wages and supervision are determined according to the efficiency wage rationale to elicit productive behaviour by employees, because in establishments that managers implement human resource practices that affect employees' productivity (which are unobserved by the econometrician), wages and supervision are expected to be lower compared to other establishments.

Estimates of the relationship of interest from specification (6) that includes controls for whether there is merit pay for unskilled manual workers and for whether appraisal systems are used for pay rise and promotion for all employees in the establishment seem to provide further support to the latter prediction.

In general, the results of estimation of wage equations from the sample of establishments in the trading sector seem to indicate that a wage-supervision trade-off may be masked by upward omitted variable bias.[111]

As the latter pattern is stronger in the private sector sample than the full sample of establishments, we next look at estimation results in the particular subsample of private and non-unionised establishments. The subsample of privately owned and non-unionized

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[111] A Hausman test rejects the null that the coefficient of supervisors to staff in specification (2) is equal to the same coefficient in specification (6), which further suggests that there is a significant positive bias resulting by the exclusion of effort related controls, as effort intensity and technology, and motivation practices. Furthermore, although we find that when a dummy for a closed shop and a dummy for whether union negotiates over staffing and working conditions dummies as well as pay are included in the estimated specification, the coefficient of the supervisor to staff ratio increases, a Hasman test suggests that the change is not significant.

establishments seems to be more interesting for the test of the wage-supervision trade-off mainly because of three reasons.

The first reason is because private and non-unionised establishments are expected to have higher ability and incentive to take advantage of the wage-supervision trade-off, as unionised establishments, may be limited in their ability to adjust wages and staffing levels and government-owned establishments may not have the same cost-minimisation incentives as privately owned establishments (Groshen and Krueger 1990).

Moreover the fact that the essence of efficiency wages is the unilateral and optimal setting of wages above the market clearing level by employers in order to overcome asymmetric information problems, renders the private and non-unionised sector the ideal one to test the validity of efficiency wages. Finally, the last reason for the selection of the private and non-unionised sector is that there are no considerations of a negative 'union power' bias in this sector private and non-unionised sample of establishments, and thus one of the explanations of the wage-supervision trade-off is dismissed.[112]

Thus, based on the later rationale, if the wage-supervision trade-off holds and since it is expected to be more pronounced for private and non-unionised establishments, it will be easier for one to trace out the trade-off in this sector, after also trying to reduce any concerns of an upward bias in the coefficient of interest by controlling for the relevant factors.

The latter conjecture seems to be supported by the results presented in table 3.3, as the estimate of the relationship between wages and supervision becomes from positive and in-

[112] The evidence produced by the full and trading sector samples does not support the prediction that a significant bias due to unobserved differences in union power across establishments is the case. Nevertheless, the pattern of change in the coefficient of interest among specifications with and without union power controls seems to be consistent with our theoretical prediction of a negative union power bias that is based on the premise that unions negotiate over effort and that they 'like' wages and 'dislike' supervision.

significant, negative and significant, after controlling for all effort related factors discussed above. A Hausman specification test supports the hypothesis that a significant positive bias is the case once the effort related controls are excluded from the estimated specification. Moreover, effort related controls as controls for effort intensity, for effort technology, and other motivation devices are jointly but also individually significant. Finally, once more we fail to find any evidence that supports a negative unobserved ability bias, provided that workforce characteristics controls are correlated with unobserved workforce quality. In particular, we find that in private and non-unionised establishments that employ an extra supervisor per manual (and clerical) employee wages are 0.06% lower.

In general, we find evidence that seems to support an efficiency wage rationale of the wage and supervision determination and which further suggests that the endogeneity bias in the estimated relationship between wages and supervision is expected to be positive and thus it may mask the wage-supervision trade-off. Moreover, after we restrict our analysis to the private and non-unionised establishments, where we expect that any wage supervision trade-off will be more pronounced, we manage to trace-out a negative relationship between wages and supervision.

The discussion presented in the previous sections indicates that there are more than one theoretical explanations of the wage-supervision trade-off. In particular, sorting out alternative theoretical explanations is another major problem that hinders many empirical studies in the field and a problem that is difficult to solve, as suggested by Groshen and Krueger (1990) and Kruse (1992).

A negative relationship between wages and supervision can be explained by: a) efficiency wages (the 'shirking' and the 'gift-exchange' versions of efficiency wage theory), b) the 'sorting by ability' model (or unobserved employees' quality, c) the theory of 'equalising differences', where supervision is viewed by employees as a 'good' working condition, d) (unobserved) occupational differences, e) and as we show in one of the previous sectors by differences in union bargaining power, when wages and supervision are determined by collective bargaining, and unions 'like' wages and 'dislike' supervision.

The 'sorting' by ability model is generally considered as the most difficult to be distinguished by efficiency wages because as also suggested by Groshen and Krueger (1990), this model is not only consistent with a wage-supervision trade-off but also with the prediction that in equilibrium, an increase in wage costs will be exactly offset by a fall in supervision costs.[113]

Although we estimate wage equations across establishments for a homogeneous in skills group of workers, there may still be unobserved ability differences that may be correlated with supervision intensity. This is the reason why we expect that the inclusion of controls for workforce characteristics such as the proportion of female employees in the unskilled manual group and the proportion of part-time employees in all manual employees may also pick up some of the differences in employees' quality.[114]

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[113] In the shirking model an increase in the wage will cause an increase in wage costs but because higher wages increase effort, wage costs will be exactly offset by a fall in supervision costs. In the 'sorting by ability' model an increase in the wage will enable firms to hire better quality employees who need less supervision and thus the higher wage costs will be offset by a fall in supervision costs.

[114] Industry dummies may also pick up some of employee quality differences.

However, the evidence in this section suggests that, provided that observed quality characteristics are correlated with unobserved, any unobserved employee quality bias doesn't seem to have the sign predicted by the 'sorting by ability' model. Moreover, we also find that the wage-supervision trade-off is generated after controlling for omitted factors (effort intensity, effort technology, etc.) that are relevant for the wage-supervision determination, based on an efficiency wage shirking rationale. This latter finding seems to provide support to the 'shirking' rather than the unobserved ability explanations of the wage-supervision trade-off.

Finally, in the 'sorting by ability' model, the wage and supervision are used as devices to determine the quality of the workforce and effort is exogenous in this model. Thus, one should expect that if the 'sorting by ability' model is true, a wage-supervision trade-off should have been the case irrespective of the inclusion of effort related controls in the estimated specifications, which is not the case here.[115]

Hence, if the sorting by ability model was actually the case we wouldn't expect that any wage-supervision trade-off would be traced out after we have controlled for effort related factors, as the latter is the exact prediction of the 'shirking' model and a relationship that arises from the non-shirking condition or the equation of isoeffort curves. Therefore, the latter discussion suggests that the 'sorting' by ability model does not seem to reconcile with the evidence of the trade-off from this section.

[115] In one of the previous sections we suggested that based on the 'sorting by ability' model isoability curves slope upwards in the wage-supervision intensity space and thus unobserved differences in ability/quality of employees across establishments will generate shifts in the isoability curves across establishments which will lead to a negative relationship between wages and supervision to be traced-out. As shifts in the isoability curves are independent of any changes in effort we would expect that, if the sorting by ability model is true, the wage-supervision trade-off would have been the case, irrespective of the inclusion of effort controls, which is not true here.

Additionally, the same arguments could be used in order to dismiss the claim that the wage-supervision trade-off is attributed to unobserved occupational differences,[116] as if occupational differences can explain the trade-off (Kruse 1992) then we should expect that controls for effort intensity, technology and other personnel motivation processes would be irrelevant, and thus the trade-off would be traced out, with or without those controls which is not the case here.

In the case that effort related controls are relevant because they are correlated with unobserved occupational differences then as the evidence suggests occupational differences will be consistent with a positive and not a negative relationship between wages and supervision. Finally, we could argue that occupational differences in general may be also due to differences in the 'effort' (in terms of intensity, diligence, etc.) and the 'quality' requirements by employees, in which case the effort and employees quality controls are expected to pick up some of the effect of occupational factors.[117] Thus, to the extent that observed occupational factors are correlated with unobserved, we could claim that occupational differences do not seem as a very appealing explanation of the wage-supervision trade-off, in this case.

Furthermore, equalising differences could explain the negative relationship between wages and supervision, if employees' 'like' supervision and thus they are willing to accept lower wages in the case they are supervised more stringently. However, in this case

[116] Unobserved occupational differences may arise in our case as we don't have any detailed information on occupational characteristics.

[117] Another reason for occupational differences is job hazard which we should expect that will cause a positive bias in the wage-supervision relationship, as when employees should be more cautious because of high probability of job accident, they should be paid a higher wage and be monitored more stringently. Other controls in our specifications as the dummy for establishment in manufacturing or services may also pick up any occupational differences.

the evidence imply a positive association of wages and supervision that operates via effort intensity and effort technology as well as through the relationship of wages and supervision intensity with other human resources motivation practices. Therefore, the evidence seems not to support a systematic negative association of wages and supervision because of employees preferences over supervision, as we find that the direction of the bias suggests that in establishments with higher supervision intensity (because of higher effort intensity requirements or more responsive effort or because of the limited use of other motivating practices) wages are also higher.[118] Equalising differences may be consistent with the finding of the positive effort bias in the estimate of the wage-supervision relationship, because higher supervision intensity has as a result higher effort and higher wages provided that employees dislike putting effort on the job. The latter argument suggests that the findings may provide more support to an equalising differences explanation of a positive rather than a negative wage-supervision relationship.

Therefore, as the wage-supervision trade-off is estimated for a sample of non-unionised private-owned establishments, the 'union-power' explanation of a negative relationship between wages and supervision does not apply in this case, and thus based on the above discussion, the evidence seem to be mostly consistent with the tenet of efficiency wages, that wages and supervision are substitutes effort regulating inputs.[119]

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[118] Alternatively, the evidence of the upward effort bias may be also consistent with the fact that wages and supervision are both negatively associated with effort and motivation, but even in this case a positive association between wages and supervision holds.

[119] Even if the above arguments are not considered as sufficient to rule out all alternative theoretical explanations of the wage-supervision trade-off in favour of efficiency wages, they do support the hypothesis that there are valid efficiency wage effects on wage-determination.

Moreover, as discussed above this can be interpreted as indirect evidence that wages affect employees productive behaviour, which as suggested in the previous sections is a necessary but not sufficient condition for the validity of efficiency wages. In other words the evidence seem to support one of the main assumptions of efficiency wages that wages affect employees productivity, but this doesn't necessarily imply that employers choose to pay higher wages in order to elicit productivity, as there are other alternatives in motivating employees except of efficiency wages.[120]

As suggested in one of the previous sections, this evidence is better to be interpreted as providing support to principal-agent models, many of which do not have the efficiency wage property. Thus, another condition that needs to be satisfied in order that the efficiency wages story is valid in the case of unskilled manual workers, is that employers set wages optimally so that wage costs are offset by a fall in supervision costs.

We would expect that the above test can be based on the wage-supervision trade-off estimate from the sample of private owned, non-unionised establishments as in these establishments wages are more likely to be determined unilaterally by employers. The estimate of wage costs produced by a 1% increase in the wage of unskilled manual employees is £1.25 per employee as the average wage of unskilled manual employees is £125.72.[121] Based on sample estimates a 1% increase in the wage is expected on average to cause a fall in supervision costs per employee equal to £38.12. Therefore our calculations suggest that

[120] In theory the standard alternatives to efficiency wages are incentive contracts as for example piece-rate contracts, bonding or steeper tenure-earnings profiles, and tournaments. Moreover, profit or ownership sharing may be another alternative.

[121] As the wage observations are grouped, the average wage of unskilled manual workers is estimated by an interval regression of unskilled wages on a constant. The estimate of the constant is the estimate of the conditional expectation of the latent unobserved unskilled manual wage variable, where conditioning is on the interval that includes the true value of the dependent variable.

the wage is set so that the marginal benefit of the higher wage exceeds the marginal cost, which further suggests that wages for unskilled manual workers have been set at a lower level than the efficiency wage, as at the efficiency wage level a marginal increase in the wage and thus in wage costs is equal to the fall in supervision costs that is generated by the wage increase.[122]

However, this latter finding cannot be used to dismiss the hypothesis that employers may pay efficiency wages, as our estimate of the trade-off may be moderated by the endogeneity bias and measurement error,[123] and thus in the presence of these problems the wage-supervision trade-off is made even more compelling.[124] Therefore, all in all the evidence in this section seem to support the main tenet of efficiency wages that wages affect employees productive behaviour and cannot dismiss efficiency wages in favour of other alternative motivation schemes.[125]

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122 This condition tests whether wages are set optimally at the efficiency wage level and not whether wages are above market clearing. However, provided that the outside option of unskilled manual employees is the average wage they can get in the non-unionised and public sector (which is the lowest wage an unskilled manual worker can get is he/she leaves his/her job) then one could argue that wages in the trading, non-unionised sector are above the market clearing wage. We find that the average wage for unskilled manual workers in the public, non-unionised sector is £45.25 which is much lower than the average wage in the private, non-unionised sector.

123 Another source of a positive bias in the coefficient of the supervisor to staff ratio is the substitution of supervisors for workers generated by the increase in the relative wage of workers (Groshen and Krueger 1990). In one of the previous sections we argued that if the 'shirking' rationale holds and if one also controls for differences in effort intensity, we should expect that the problem of substitution is moderated. However, even if substitution occurs in our case and provided that the substitution bias is expected to be positive, this makes our estimate of the trade-off even more compelling.

124 As suggested above by the OLS equivalence of the MLEs of the parameters of interest showed by Stewart (1983), measurement error is expected to attenuate the estimated coefficient of interest. Thus, based on the evidence of a positive endogeneity bias, we expect that our estimates of the wage-supervision trade-off will be smaller in magnitude in the presense of endogeneity and measurement error. Based on the sample estimates used in our calculations above, we need an estimate of the trade-off of around 0.27 in order that the fall in supervision costs exactly offsets a 1% increase in wages for unskilled manual employees.

125 As far as the validity and robustness of our results is concerned, the model we use for estimation and inference, as well as interpretation may be inadequate i.e misspecified. In this case the main specification assumptions of the interval regression estimation technique are that: a) the model is linear, b) the error is homoscedastic and normally distributed, and c) there are no omitted variables. Because Stewart (1983) showed

3.6.2 Semi-Skilled

In this subsection we use the same methodology as in the previous section in order to identify the relationship between wages of semi-skilled manual workers and the intensity of supervision across establishments. Results are summarised in tables 3.4 to 3.6 (see table section at the end). Table 3.4 presents estimation of semi-log wage equations for semi-skilled manual employees using the full sample of establishments observations in WIRS 1990.

The main results are similar to the analogous case for unskilled manual employees. In particular, we fail to find any statistically significant estimates of the relationship between wages and supervision, as estimates turn from positive and insignificant to zero, once con-

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that the MLEs of the parameters of the above model are equivalent to the OLS estimators from a regression of the conditional expectation of the latent unobserved variable on exogenous variables, we expect that the violation of the above assumptions will have the same implications as in the standard general linear framework. Thus, non-normality should not be a problem as long as the sample size is sufficiently large, but heteroscedasticity will lead to inefficient estimates and invalid inferences when the standard errors are estimated under the assumption that the model is correct. Similarly, we would expect that omission of relevant variables will lead to biased and inconsistent estimates. In our case we have already suggested that the main causing variable of interest i.e supervision intensity is endogenous, and although we attempt to tackle the endogeneity problem by controlling for confounding variables, the main aim of our empirical strategy is to identify the direction of the endogeneity bias and use the evidence on the direction of the bias to assess the validity of the main theoretical explanations of the relationship between wages and supervision. Although, endogeneity may be limited after controlling for some confounding factors, it is expected to remain a problem and that is why we expect that our model is misspecified. However, valid inferences can be produced, even under misspecification, as long as inferences are based on estimated asymptotic robust standard errors. In particular, White (1982) showed that under misspecification, the standard Wald and LM tests based on the robust variance covariance matrix of the MLE, have the proper size, are asymptotically equivalent and are asymptotically distributed as chi-squared with degrees of freedom calculated in the traditional fashion. White also showed that the same is not the case for the LR test. Moreover, White showed that the Quasi-MLE (QMLE, the MLE under misspecification), is a consistent estimator of the parameters that minimize the Kullback-Leibler information criterion, and is asymptotically normal. This simply means that the QMLE minimizes our ignorance about the true structure or loosely speaking that consistently estimates the parameters that are the closest to the true parameters (Johnston and Dinardo 1997). Therefore, the above synthesis of seminal results on interval regression and ML estimation, suggests that our inferences are valid, as long as they are based on asymptotic robust standard errors, and that any endogeneity and measurement error bias of our estimates will be minimum. A simple test of the violation of the assumptions of model specification when the dependent variable is grouped is presented by Chesher and Irish (1987).

trols for effort intensity, effort technology and for other motivation devices are gradually introduced in the estimated specification.

The pattern of change in the coefficient of interest across specifications that gradually include 'effort related' controls seems to support the prediction of a positive endogeneity bias, which according to our theoretical analysis of the previous sections seems to be consistent with a 'shirking' efficiency wages rationale. However, a Hausman specification test suggests that the change in the coefficient of the supervisor to staff ratio generated by the inclusion of effort intensity and technology controls as well as controls for the extent at which other practices are used to motivate employees, as merit pay for semi-skilled manual employees and the use of appraisal for pay rises and promotion, is not significant.[126]

Moreover, again we fail to find any evidence that support either the prediction of a negative unobserved employees' quality bias, as predicted by the 'sorting by ability' model or a negative bias because of unobserved differences in union power across establishments.

Although we don't find any strong evidence of an upward omitted variable bias for the full-sample of establishments, the findings may be indicative of an upward bias in the coefficient of interest and that is why we next turn to investigate the wage-supervision relationship for establishments in the private sector in particular, where as argued in the previous section the wage-supervision trade-off may be more pronounced.

Table 3.5 summarises results from the subsample of all establishments in the private (trading) sector. The findings again are in line with the analogous case of unskilled manual

[126] In general effort related controls are jointly significant but only the dummies for merit pay and appraisal systems for pay rises and promotion are individually significant. The effects of other controls such as size, industry affiliation, ownership and union recognition dummies on semi-skilled employees wages are significant and their signs are consistent with other empirical results from the relevant literature.

employees, although in this case the estimated coefficient of interest turns from positive and significant to negative but insignificant. Although, the pattern of change in the coefficient of supervision intensity across the specifications of table 3.6 seem to support the prediction of a positive endogeneity bias, we fail to find any evidence that the estimated coefficient of the supervisor to staff ratio from specification (6) (in which all effort related controls have been included) is systematically larger (in absolute value or more negative) from the analogous coefficient in specification (2) (where no effort related controls have been included).[127]

Furthermore, table 3.6 summarises results for the subsample of trading sector and non-unionised establishments. In this case, in contrast to our analysis for unskilled manual workers, we fail to find a negative and significant estimate of the relationship between supervision intensity and wages, or even evidence of a significant positive upward bias due to unobserved differences in effort intensity, technology or for the implementation of personnel policies to motivate semi-skilled manual employees. Moreover, in contrast to the analogous case of the previous section, the evidence from this section does not seem to support the conjecture that if the wage-supervision trade-off holds, it is more pronounced in the private and non-unionised sector. However, the pattern of the change in the coefficient of interest across specifications of table 3.6 as well as the significance of effort related controls is consistent with the prediction of a positive endogeneity bias.

All in all the evidence for the case of semi-skilled manual employees suggest no systematic relationship between wages and supervision (the estimated coefficient tends to

[127] The Hausman test cannot reject the null that the coefficients of the two specifications are equal. Moreover, note that effort intensity, effort technology and motivation devices controls are jointly and individually significant.

zero). However, the fact that the pattern of change in the coefficient of the supervisor to staff variable seems to be consistent with the prediction of a positive endogeneity bias combined with further concerns for endogeneity bias, measurement error and substitution of supervisors for supervised employees that mask any wage-supervision trade-off that may be in operation, may further suggest that one cannot rule out efficiency wage theory in the case of semi-skilled manual employees, even though we find no significant evidence of a wage-supervision trade-off. Finally, once more we fail to find any evidence in favour of negative bias generated either by unobserved differences in employees' quality[128] or by unobserved differences in union's bargaining power.

3.6.3 Skilled

In this section we present estimation results from semi-log wage equations for skilled manual workers.[129] The results are summarised in tables 3.7 to 3.9.

Table 3.7 presents results for the full sample of establishments in WIRS 1990. Our findings for skilled manual employees for the full sample of establishments are consistent with the findings for unskilled and semi-skilled in the analogous sample. In particular, the coefficient of interest tends closer to zero once effort related controls are gradually introduced in the estimated specification, although no evidence can be provided that there is

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[128] There are other studies with findings that cast doubt to the validity of the prediction of the 'sorting by ability' model of a negative omitted variable bias in the relationship between wages and supervision. For example Neal (1993) presents evidence that jobs in high-wage, primary sector industries supervision is at least as intensive as in jobs in low-wage, secondary sector industries. This finding may further suggest that provided that workers in high-wage, primary sector jobs are of higher quality and are paid higher wages but are not less stringently supervised than low-quality workers in secondary sector jobs.

[129] Based on WIRS 1990 definition, skilled manual workers are manual employees who have received formal training through apprenticeship or its equivalent.

significant positive bias generated from unobserved differences in effort related controls.[130] Moreover, on the one hand we fail to find any support to the prediction of a negative 'employees' ability' bias, but on the other hand the evidence suggests that there is a significant negative bias in the coefficient of interest due to unobserved differences in union's bargaining power, a finding which supports our theoretical prediction based on the assumptions that unions negotiate over pay and supervision and 'like' wages but 'dislike' supervision.[131]

Furthermore, as in previous sections if we restrict our analysis to the sample of establishments in the trading sector we find some indication of a wage-supervision trade-off, although the estimate of the trade-off is slightly insignificant, as presented in table 3.8. In this case also the evidence seems to support the prediction of a negative relationship between wages and supervision intensity that may be masked by omitted variable bias, which may be further consistent with an efficiency wage rationale of wage and supervision determination. However, once more we fail to find any evidence that the observed positive bias is significant.

Finally, results for the non-unionised subset of establishments in the trading sector presented in table 3.9 indicate the same pattern of change in the coefficient of interest across specifications, as for unskilled and semi-skilled but the estimate of the wage-supervision

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130 A Hausman specification test cannot reject the null that the coefficient of the supervisor to staff from specification (2) is equal to the same coefficient from specification (6). Note also that effort related controls are jointly significant but only the dummies for all other costs to labour costs share and the dummies for subjective work intensity are individually singificant.

131 A Hausman test suggests that the coefficient of interest is systematically larger in magnitude in specifications that include dummies for closed shop and for union bargaining over staffing and working conditions compared to specifications which do not include union power controls. Another interesting finding is that even though estimated effects of other controls as size, industry affiliation etc, have the expected sign the union recognition dummy is insignificant in all estimated specifications, which may suggest that there is no union wage differential for skilled manual workers.

relationship is negative but insignificant. Again, as in the case of semi-skilled manual employees, no evidence can be provided of a significant positive bias in the coefficient of the supervisor to staff ratio.[132]

In general, in this section we fail to find any evidence of a significant relationship (positive or negative) between wages and supervision for skilled manual workers. Moreover, although the change in the coefficient of interest across different specifications which gradually include effort related controls seems consistent with a positive omitted variable bias, we fail to find systematic evidence of a significant upward bias. This finding may be interpreted in terms of the rationale that as higher wages generate also an income and not only an incentive effect on employees' behaviour and as any income effect is expected to be higher for relatively skilled employees that are paid relatively higher wages,[133] it may be the case that the wage has no effect on employees effort as the income effect offsets the incentive effect of the wage.

Finally, we find some support for the theoretical prediction presented in one of the previous section that a negative bias in the coefficient of interest may be the result of unobserved differences in union bargaining power across establishments, but once again we fail to find any evidence that supports a negative employees quality bias in the estimate of the coefficient of supervision intensity.

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[132] A Hausman test cannot reject the null that the coefficient of supervisor to staff ratio in specification (2) is equal to the same coefficient from specification (6). The effort intensity and effort technology controls as well as controls for personnel policies for motivating skilled manual employees are jointly significant but only the effort intensity controls (all other costs to labour costs share ratio and subjective effort dummies) are individually significant.

[133] Recall that in the case of labour supply, the evidence suggests that the income effect is more likely to more than offset the substitution effect, the higher is the wage/income of the economic agent.

3.7 Conclusions

Efficiency wages explanation of involuntary unemployment and other labour market phenomena cannot be ruled out on a priori theoretical grounds, and thus evidence is needed. More importantly, there is no conclusive evidence as far as the validity of efficiency wages is concerned (Manning and Thomas 1997, Autor 2003).

The main empirical question in the field of efficiency wages, is twofold: Is it true that higher wages increase employee's productivity or quality? Given that the latter hypothesis holds, and thus it pays to increase wages; Is it true that employers prefer to pay efficiency wages in order to elicit productivity or enhance quality of employees, instead of using alternative means (bonding or entry fees)?

There is direct evidence on the first empirical question as provided by empirical studies that try to estimate the effects of wages on productivity (Wadwhani and Wall 1991, Konings and Walsh 1994, Levine 1992). There is also indirect evidence, from the wage structure across industries (Krueger and Summers 1988, Kruse 1992), that supports the efficiency wages story. However, on the one hand empirical studies that provide direct evidence suffer from endogeneity and identification problems and on the other hand studies of inter-industry wage differentials do not seem to support efficiency wages because the relationship between industry wage differentials and efficiency wages seems tenuous (Manning and Thomas 1997).

There is another empirical approach in the testing of efficiency wages, which is particularly concerned with the predictions of the 'shirking' and the 'gift-exchange' models of efficiency wages and seems to be relatively neglected in the literature (Manning and

Thomas 1997). In particular, both models predict that if the wage is increased, for given effort, monitoring intensity should be relaxed, even though this is done via a different mechanism in each model.

In the 'shirking' model this is the case because the higher wage imposes a penalty to the shirker if caught and being dismissed, whereas in the "gift-exchange model" this occurs because the higher wage creates a climate of cooperation and reciprocity. This prediction of these efficiency wages models provides a way to conduct an indirect test of the effects of wages on productivity which is a necessary condition for the validity of efficiency wages.

Most of the empirical studies that try to estimate the wage-supervision trade-off (Fitzroy and Kraft, 1986, Leonard, 1987, Neal, 1993, Brunnello, 1995) fail to find any conclusive evidence probably because of endogeneity bias, as the intensity of supervision, is endogenously and simultaneously determined with wages. Moreover, measurement error in the supervision variable exacerbates estimation problems generated by endogeneity.

Another major problem of empirical studies of the wage-supervision trade-off is that they fail to distinguish between alternative theories or explanations of the wage-supervision trade-off (Groshen and Krueger 1990) and therefore any evidence produced by these studies cannot be used to support or dismiss the validity of efficiency wages. Finally, any empirical attempts that address the above problems (Groshen and Krueger, 1990, Krueger, 1991, Rebitzer, 1995) provide evidence that supports only one of the two main empirical questions for efficiency wages and their results cannot be generalised as they focus on particular industries.

In this chapter, we present an empirical test of the efficiency wage theory, which is based on testing the prediction of the 'shirking' and 'gift-exchange' models, that in equilibrium, ceteris paribus, higher wages are associated with lower intensity of supervision, using establishment level data from WIRS 1990.

Our identification strategy is based on the estimation of the equation of isoeffort curves derived from the firm's production function, by exploiting variation in supervision intensity generated by variation in supervision costs (the wage of supervisors) across regions and industries. In order to reduce the endogeneity bias arising from omitted variables and the simultaneous determination of wages and supervision intensity, we include controls for omitted variables that according to efficiency wages are correlated with wages and supervision. In this way, we test for efficiency wages by testing whether there is a bias generated by omission of variables that the efficiency wage theory predicts that are correlated with wages and supervision and whether the direction of the omitted variable bias is consistent with efficiency wage theory predictions. The above strategy, under certain conditions, also enables us to sort out alternative explanations of a wage-supervision trade-off. Moreover, we also provide a novel theoretical explanation of a negative relationship between wages and supervision that suggests that a wage-supervision trade-off may be the result of negative bias generated by unobserved differences in trade union's bargaining power across establishments, when wages and supervision are determined by firm-union bargaining and unions 'like' higher wages but 'dislike' stringent supervision. Although our strategy enables us to reduce the bias, it does not eliminate it and thus the endogeneity problem that is widely faced by the majority of studies in the topic is also a problem of this study. Therefore, we our main contribution is to investigate the hypothesis of the wage/supervision trade-off using UK establishment data, in contrast to existing studies in the filed that have been focused on US data or data from other European countries.

In the case of unskilled manual workers we find evidence of a significant trade-off between wages and supervision which supports the main tenet of efficiency wages that higher wages are positively correlated with employees' productivity. After also testing whether employers pay efficiency wages in order to elicit productive behaviour by employees, by testing whether higher wages 'pay for themselves' we find no evidence that can rule out efficiency wages in favour of alternative motivation devices.

In the case of semi-skilled and skilled manual workers, the evidence suggests that there is no systematic relationship between wages and supervision or that the wage-supervision relationship is negative but insignificant. However, the pattern of results in the case of semi-skilled and skilled manual workers is fairly similar to that of unskilled and is consistent with a positive omitted variable bias predicted by the efficiency wages theory. Moreover, in the case of skilled manual employees we find some evidence of a small negative 'union power' bias.

In conclusion, we find some evidence that suggests that there are may exist valid efficiency wages considerations for unskilled manual employees but not for semi-skilled and skilled manual employees. This finding seems to provide some support to the main tenet of the thesis that efficiency wages may be more relevant for low-wage employees and that is why the efficiency wage theory may be particularly fruitful in explaining observed phenomena from low-wage labour markets.

3.8 Tables

Table 3.1: Maximum Likelihood Estimation of Wage Equations for Unskilled Manual Employees (Full Sample) (Dependent variable is the log median wage for the majority gender in the unskilled manual group)

Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)
Supervisors to staff ratio	0.097 (0.073)	0.018 (0.04)	0.007 (0.04)	0.01 (0.048)	0.014 (0.044)	0.006 (0.043)
Dummies for establishment size	Yes	Yes	Yes	Yes	Yes	Yes
Dummy for establishment in manufacturing	0.053 (0.073)	0.05 (0.02)	0.05 (0.02)	0.052 (0.021)	0.051 (0.021)	0.055 (0.022)
Dummy for establishment in trading sector	0.43 (0.032)	0.24 (0.02)	0.22 (0.029)	0.22 (0.029)	0.22 (0.029)	0.22 (0.029)
Dummy for union recognition for manual	0.24 (0.048)	0.12 (0.03)	0.12 (0.039)	0.12 (0.04)	0.12 (0.04)	0.12 (0.04)
Proportion female in unskilled manual		-0.62 (0.03)	-0.62 (0.039)	-0.62 (0.039)	-0.62 (0.031)	-0.62 (0.031)
Proportion part-time in manual		-0.001 (0.001)	-0.002 (0.001)	-0.002 (0.001)	-0.002 (0.001)	-0.002 (0.001)
Dummies for all other costs to labour costs ratio			Yes	Yes	Yes	Yes
Work intensity dummies				Yes	Yes	Yes
Effort Technology controls					Yes	Yes
Controls for other personnel policies						Yes
Weight	-0.031 (0.034)	-0.019 (0.027)	-0.018 (0.027)	-0.018 (0.027)	-0.015 (0.027)	-0.014 (0.027)
Constant	4.3 (0.12)	4.8 (0.1)	4.89 (0.14)	4.96 (0.11)	4.97 (0.17)	4.98 (0.12)
Sample size	1120	1120	1120	1120	1120	1120

Notes: Asymptotic robust standard errors in parentheses. Establishment size dummies include 8 dummies for if number of employees is between 25 and 50, 50 and 100, 100 and 200, 200 and 500, 500 and 1000, 1000 and 2000, 2000 and 5000, 5000 and 10000 respectively. Effort technology controls include a dummy for other benefits for unskilled manual, the proportion of non-redundant dismissed employees and the proportion of sanctioned employees due to disciplinary reasons in the previous year. Other personnel policies controls include dummies for merit pay for unskilled manual and for whether all employees are under appraisal for promotion and pay rises. The inclusion of 'union power' controls as dummies for closed shop and for whether recognised unions negotiate over manning/staffing, etc. in (6) results in an estimated coefficient of the supervisor to staff ratio of 0.009. A generalised Hausman test cannot reject the null that the coefficient of the supervisor to staff ratio in model (6) is the same with or without 'union power' controls, as well as it cannot also reject the null when the same test is about inclusion of controls for effort intensity, effort technology and other motivation devices.

Table 3.2: Maximum Likelihood Estimation of Wage Equations for Unskilled Manual Employees (Trading Sector Sample) (Dependent variable is the log median wage for the majority gender in the unskilled manual group)

Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)
Supervisors to staff ratio	0.082 (0.071)	0.021 (0.039)	-0.0015 (0.039)	-0.0007 (0.04)	-0.006 (0.037)	-0.0156 (0.035)
Dummies for establishment size	Yes	Yes	Yes	Yes	Yes	Yes
Dummy for establishment in manufacturing	0.059 (0.025)	-0.049 (0.014)	-0.05 (0.02)	-0.048 (0.02)	-0.047 (0.02)	-0.042 (0.02)
Dummy for union recognition for manual	0.19 (0.051)	0.013 (0.039)	0.021 (0.04)	0.021 (0.039)	0.023 (0.039)	0.024 (0.04)
Proportion female in unskilled manual		-0.31 (0.03)	-0.31 (0.03)	-0.3 (0.03)	-0.3 (0.03)	-0.29 (0.03)
Proportion part-time in manual		-0.65 (0.05)	-0.65 (0.05)	-0.67 (0.05)	-0.68 (0.059)	-0.68 (0.05)
Dummies for all other costs to labour costs ratio			Yes	Yes	Yes	Yes
Work intensity dummies				Yes	Yes	Yes
Effort Technology controls					Yes	Yes
Controls for other personnel policies						Yes
Weight	0.019 (0.041)	0.026 (0.02)	0.03 (0.02)	0.027 (0.026)	0.029 (0.026)	0.026 (0.026)
Constant	4.66 (0.14)	5.06 (0.09)	5.17 (0.17)	5.28 (0.18)	5.27 (0.13)	5.28 (0.13)
Sample size	817	817	817	817	817	817

Notes: Asymptotic robust standard errors in parentheses. Establishment size dummies include 8 dummies for if number of employees is between 25 and 50, 50 and 100, 100 and 200, 200 and 500, 500 and 1000, 1000 and 2000, 2000 and 5000, 5000 and 10000 respectively. Effort technology controls include a dummy for other benefits for unskilled manual, the proportion of non-redundant dismissed employees and the proportion of sanctioned employees due to disciplinary reasons in the previous year. Other personnel policies controls include dummies for merit pay for unskilled manual and for whether all employees are under appraisal for promotion and pay rises. The inclusion of 'union power' controls as dummies for closed shop and for whether recognised unions negotiate over manning/staffing, etc. in (6) results in an estimated coefficient of the supervisor to staff ratio of -0.0149. A generalised Hausman test cannot reject the null that the coefficient of the supervisor to staff ratio in model (6) is the same with or without 'union power' controls, but it can reject the null when the test is about joint inclusion of controls for effort intensity, effort technology and other motivation devices.

Table 3.3: Maximum Likelihood Estimation of Wage Equations for Unskilled Manual Employees (Trading and Non-Unionised Sector Sample) (Dependent variable is the log median wage for the majority gender in the unskilled manual group)

Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)
Supervisors to staff ratio	0.06 (0.056)	-0.0005 (0.034)	-0.023 (0.034)	-0.028 (0.033)	-0.047 (0.031)	-0.06 (0.03)
Dummies for establishment size	Yes	Yes	Yes	Yes	Yes	Yes
Dummy for establishment in manufacturing	0.2 (0.04)	-0.018 (0.036)	0.02 (0.036)	-0.028 (0.036)	-0.038 (0.037)	-0.011 (0.03)
Proportion female in unskilled manual		-0.034 (0.067)	-0.32 (0.06)	-0.32 (0.06)	-0.29 (0.062)	-0.3 (0.06)
Proportion part-time in manual		-0.62 (0.079)	-0.63 (0.08)	-0.63 (0.078)	-0.66 (0.08)	-0.65 (0.08)
Dummies for all other costs to labour costs ratio			Yes	Yes	Yes	Yes
Work intensity dummies				Yes	Yes	Yes
Effort Technology controls					Yes	Yes
Controls for other personnel policies						Yes
Weight	0.004 (0.05)	0.01 (0.03)	0.007 (0.034)	0.001 (0.033)	0.003 (0.034)	0.009 (0.033)
Constant	4.6 (0.13)	5.01 (0.1)	5.17 (0.17)	5.13 (0.15)	5.12 (0.16)	5.17 (0.16)
Sample size	300	300	300	300	300	300

Notes: Asymptotic robust standard errors in parentheses. Establishment size dummies include 8 dummies for if number of employees is between 25 and 50, 50 and 100, 100 and 200, 200 and 500, 500 and 1000, 1000 and 2000, 2000 and 5000, 5000 and 10000 respectively. Effort technology controls include a dummy for other benefits for unskilled manual, the proportion of non-redundant dismissed employees and the proportion of sanctioned employees due to disciplinary reasons in the previous year. Other personnel policies controls include dummies for merit pay for unskilled manual and for whether all employees are under appraisal for promotion and pay rises. A generalised Hausman test rejects the null that the coefficient of the supervisor to staff ratio in model (6) and in model (2) where no controls

Table 3.4: Maximum Likelihood Estimation of Wage Equations for Semi-Skilled Manual Employees (Full Sample) (Dependent variable is the log median wage for the majority gender in the semi-skilled manual group)

Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)
Supervisors to staff ratio	0.14 (0.09)	0.039 (0.059)	0.03 (0.057)	0.03 (0.057)	0.011 (0.057)	0.0038 (0.059)
Dummies for establishment size	Yes	Yes	Yes	Yes	Yes	Yes
Dummy for establishment in manufacturing	0.049 (0.023)	0.047 (0.019)	0.05 (0.02)	0.048 (0.02)	0.053 (0.02)	0.053 (0.02)
Dummy for establishment in trading sector	0.29 (0.031)	0.18 (0.027)	0.17 (0.028)	0.17 (0.028)	0.16 (0.029)	0.16 (0.029)
Dummy for union recognition for manual	0.14 (0.05)	0.1 (0.041)	0.09 (0.04)	0.09 (0.04)	0.09 (0.04)	0.09 (0.04)
Proportion female in semi-skilled manual		-0.54 (0.03)	-0.54 (0.031)	-0.54 (0.031)	-0.54 (0.031)	-0.54 (0.031)
Proportion part-time in manual		-0.001 (0.0005)	-0.001 (0.0005)	-0.001 (0.0005)	-0.001 (0.0005)	-0.001 (0.0005)
Dummies for all other costs to labour costs ratio			Yes	Yes	Yes	Yes
Work intensity dummies				Yes	Yes	Yes
Effort Technology controls					Yes	Yes
Controls for other personnel policies						Yes
Weight	-0.047 (0.03)	-0.034 (0.023)	-0.036 (0.023)	-0.034 (0.023)	-0.033 (0.023)	-0.033 (0.023)
Constant	4.72 (0.11)	4.98 (0.089)	4.93 (0.11)	5.04 (0.11)	5.05 (0.17)	5.05 (0.17)
Sample size	908	908	908	908	908	908

Notes: Asymptotic robust standard errors in parentheses. Establishment size dummies include 8 dummies for if number of employees is between 25 and 50, 50 and 100, 100 and 200, 200 and 500, 500 and 1000, 1000 and 2000, 2000 and 5000, 5000 and 10000 respectively. Effort technology controls include a dummy for other benefits for semi-skilled manual, the proportion of non-redundant dismissed employees and the proportion of sanctioned employees due to disciplinary reasons in the previous year. Other personnel policies controls include dummies for merit pay for semi-skilled manual and for whether all employees are under appraisal for promotion and pay rises. The inclusion of 'union power' controls as dummies for closed shop and for whether recognised unions negotiate over manning/staffing, etc. in (6) results in an estimated coefficient of the supervisor to staff ratio of 0.013. A generalised Hausman test cannot reject the null that the coefficient of the supervisor to staff ratio in model (6) is the same with or without 'union power' controls as well as cannot also reject the null when the test is about joint inclusion of controls for effort intensity, effort technology and other motivation devices.

Table 3.5: Maximum Likelihood Estimation of Wage Equations for Semi-Skilled Manual Employees (Trading Sector Sample) (Dependent variable is the log median wage for the majority gender in the semi-skilled manual group)

Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)
Supervisors to staff ratio	0.17 (0.08)	-0.034 (0.057)	-0.049 (0.06)	-0.049 (0.059)	-0.06 (0.06)	-0.057 (0.074)
Dummies for establishment size	Yes	Yes	Yes	Yes	Yes	Yes
Dummy for establishment in manufacturing	0.049 (0.02)	0.005 (0.019)	0.004 (0.019)	0.001 (0.019)	0.002 (0.01)	0.005 (0.019)
Dummy for union recognition for manual	0.11 (0.054)	0.06 (0.04)	0.062 (0.04)	0.049 (0.042)	0.051 (0.041)	0.054 (0.04)
Proportion female in semi-skilled manual		-0.46 (0.035)	-0.46 (0.03)	-0.46 (0.03)	-0.46 (0.035)	-0.46 (0.034)
Proportion part-time in manual		-0.4 (0.06)	-0.41 (0.06)	-0.4 (0.06)	-0.41 (0.065)	-0.41 (0.065)
Dummies for all other costs to labour costs ratio			Yes	Yes	Yes	Yes
Work intensity dummies				Yes	Yes	Yes
Effort Technology controls					Yes	Yes
Controls for other personnel policies						Yes
Weight	-0.054 (0.02)	-0.046 (0.024)	-0.05 (0.02)	-0.04 (0.02)	-0.048 (0.024)	-0.046 (0.024)
Constant	5.04 (0.12)	5.24 (0.08)	5.32 (0.09)	5.35 (0.11)	5.55 (0.11)	5.55 (0.11)
Sample size	764	764	764	764	764	764

Notes: Asymptotic robust standard errors in parentheses. Establishment size dummies include 8 dummies for if number of employees is between 25 and 50, 50 and 100, 100 and 200, 200 and 500, 500 and 1000, 1000 and 2000, 2000 and 5000, 5000 and 10000 respectively. Effort technology controls include a dummy for other benefits for semi-skilled manual, the proportion of non-redundant dismissed employees and the proportion of sanctioned employees due to disciplinary reasons in the previous year. Other personnel policies controls include dummies for merit pay for semi-skilled manual and for whether all employees are under appraisal for promotion and pay rises. The inclusion of 'union power' controls as dummies for closed shop and for whether recognised unions negotiate over manning/staffing, etc. in (6) results in an estimated coefficient of the supervisor to staff ratio of -0.053. A generalised Hausman test cannot reject the null that the coefficient of the supervisor to staff ratio in model (6) is the same with or without 'union power' controls as well as cannot also reject the null when the test is about joint inclusion of controls for effort intensity, effort technology and other motivation devices.

Table 3.6: Maximum Likelihood Estimation of Wage Equations for Semi-Skilled Manual Employees (Trading and Non-Unionised Sector Sample) (Dependent variable is the log median wage for the majority gender in the semi-skilled manual group)

Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)
Supervisors to staff ratio	0.22 (0.13)	0.067 (0.08)	0.062 (0.064)	0.051 (0.08)	0.071 (0.078)	0.037 (0.08)
Dummies for establishment size	Yes	Yes	Yes	Yes	Yes	Yes
Dummy for establishment in manufacturing	0.18 (0.043)	0.053 (0.038)	0.05 (0.039)	0.047 (0.04)	0.047 (0.04)	0.056 (0.039)
Proportion female in semi-skilled manual		-0.4 (0.06)	-0.39 (-0.06)	-0.4 (0.06)	-0.4 (0.06)	-0.39 (0.065)
Proportion part-time in manual		-0.4 (0.09)	-0.41 (0.09)	-0.41 (0.09)	-0.41 (0.09)	-0.43 (0.096)
Dummies for all other costs to labour costs ratio			Yes	Yes	Yes	Yes
Work intensity dummies				Yes	Yes	Yes
Effort Technology controls					Yes	Yes
Controls for other personnel policies						Yes
Weight	-0.027 (0.047)	-0.04 (0.03)	-0.04 (0.03)	-0.04 (0.033)	-0.04 (0.033)	-0.055 (0.036)
Constant	4.89 (0.15)	5.2 (0.11)	5.4 (0.14)	5.3 (0.15)	5.3 (0.15)	5.47 (0.18)
Sample size	252	252	252	252	252	252

Notes: Asymptotic robust standard errors in parentheses. Establishment size dummies include 8 dummies for if number of employees is between 25 and 50, 50 and 100, 100 and 200, 200 and 500, 500 and 1000, 1000 and 2000, 2000 and 5000, 5000 and 10000 respectively. Effort technology controls include a dummy for other benefits for semi-skilled manual, the proportion of non-redundant dismissed employees and the proportion of sanctioned employees due to disciplinary reasons in the previous year. Other personnel policies controls include dummies for merit pay for semi-skilled manual and for whether all employees are under appraisal for promotion and pay rises. A generalised Hausman test cannot reject the null that the coefficient of the supervisor to staff ratio in model (6) and in model (2) where no controls for effort intensity, effort technology and other motivation devices are included, are equal.

Table 3.7: Maximum Likelihood Estimation of Wage Equations for Skilled Manual Employees (Full Sample) (Dependent variable is the log median wage for the majority gender in the skilled manual group)

Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)
Supervisors to staff ratio	0.094 (0.13)	0.047 (0.12)	0.036 (0.12)	0.04 (0.12)	0.027 (0.12)	0.033 (0.11)
Dummies for establishment size	Yes	Yes	Yes	Yes	Yes	Yes
Dummy for establishment in manufacturing	0.087 (0.023)	0.077 (0.021)	0.079 (0.021)	0.079 (0.021)	0.08 (0.021)	0.078 (0.021)
Dummy for establishment in trading sector	0.28 (0.028)	0.21 (0.026)	0.21 (0.027)	0.21 (0.027)	0.21 (0.027)	0.19 (0.02)
Dummy for union recognition for manual	0.013 (0.047)	-0.006 (0.043)	-0.006 (0.04)	-0.006 (0.04)	-0.0007 (0.04)	0.001 (0.043)
Proportion female in skilled manual		-0.53 (0.044)	-0.53 (0.044)	-0.53 (0.044)	-0.52 (0.044)	-0.51 (0.044)
Proportion part-time in manual		-0.0045 (0.01)	-0.005 (0.001)	-0.005 (0.001)	-0.005 (0.001)	-0.004 (0.001)
Dummies for all other costs to labour costs ratio			Yes	Yes	Yes	Yes
Work intensity dummies				Yes	Yes	Yes
Effort Technology controls					Yes	Yes
Controls for other personnel policies						Yes
Weight	-0.029 (0.034)	-0.032 (0.029)	-0.034 (0.029)	-0.034 (0.029)	-0.033 (0.029)	-0.036 (0.028)
Constant	4.97 (0.12)	5.11 (0.1)	5.19 (0.19)	5.19 (0.19)	5.19 (0.19)	5.19 (0.18)
Sample size	1087	1087	1087	1087	1087	1087

Notes: Asymptotic robust standard errors in parentheses. Establishment size dummies include 8 dummies for if number of employees is between 25 and 50, 50 and 100, 100 and 200, 200 and 500, 500 and 1000, 1000 and 2000, 2000 and 5000, 5000 and 10000 respectively. Effort technology controls include a dummy for other benefits for skilled manual, the proportion of non-redundant dismissed employees and the proportion of sanctioned employees due to disciplinary reasons in the previous year. Other personnel policies controls include dummies for merit pay for skilled manual and for whether all employees are under appraisal for promotion and pay rises. The inclusion of 'union power' controls as dummies for closed shop and for whether recognised unions negotiate over manning/staffing, etc. in (6) results in an estimated coefficient of the supervisor to staff ratio of 0.05. A generalised Hausman test rejects the null that the coefficient of the supervisor to staff ratio in model (6) is the same with or without 'union power' controls, but it cannot reject the null when the test is about joint inclusion of controls for effort intensity, effort technology and other motivation devices.

Table 3.8: Maximum Likelihood Estimation of Wage Equations for Skilled Manual Employees (Trading Sector Sample) (Dependent variable is the log median wage for the majority gender in the skilled manual group)

Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)
Supervisors to staff ratio	0.15 (0.17)	-0.1 (0.11)	-0.13 (0.1)	-0.133 (0.11)	-0.083 (0.1)	-0.13 (0.1)
Dummies for establishment size	Yes	Yes	Yes	Yes	Yes	Yes
Dummy for establishment in manufacturing	0.089 (0.024)	0.008 (0.019)	0.013 (0.02)	0.014 (0.02)	0.022 (0.019)	0.02 (0.019)
Dummy for union recognition for manual	-0.003 (0.052)	-0.064 (0.041)	-0.054 (0.041)	-0.051 (0.041)	-0.044 (0.041)	-0.043 (0.041)
Proportion female in skilled manual		-0.37 (0.055)	-0.36 (0.054)	-0.36 (0.054)	-0.34 (0.052)	-0.34 (0.052)
Proportion part-time in manual		-0.62 (0.067)	-0.64 (0.06)	-0.63 (0.065)	-0.62 (0.063)	-0.62 (0.063)
Dummies for all other costs to labour costs ratio			Yes	Yes	Yes	Yes
Work intensity dummies				Yes	Yes	Yes
Effort Technology controls					Yes	Yes
Controls for other personnel policies	-0.003 (0.039)	-0.024 (0.03)	-0.027 (0.03)	-0.026 (0.028)	-0.021 (0.028)	-0.019 (0.028)
Weight	5.24 (0.14)	5.43 (0.11)	5.53 (0.15)	5.64 (0.14)	5.56 (0.14)	5.53 (0.14)
Constant	887	887	887	887	887	887

Notes: Asymptotic robust standard errors in parentheses. Establishment size dummies include 8 dummies for if number of employees is between 25 and 50, 50 and 100, 100 and 200, 200 and 500, 500 and 1000, 1000 and 2000, 2000 and 5000, 5000 and 10000 respectively. Effort technology controls include a dummy for other benefits for skilled manual, the proportion of non-redundant dismissed employees and the proportion of sanctioned employees due to disciplinary reasons in the previous year. Other personnel policies controls include dummies for merit pay for skilled manual and for whether all employees are under appraisal for promotion and pay rises. The inclusion of 'union power' controls as dummies for closed shop and for whether recognised unions negotiate over manning/staffing, etc. in (6) results in an estimated coefficient of the supervisor to staff ratio of -0.1. A generalised Hausman test cannot reject the null that the coefficient of the supervisor to staff ratio in model (6) is the same with or without 'union power' controls, as well as it cannot also reject the null when the test is about inclusion of controls for effort intensity, effort technology and other motivation devices.

Table 3.9: Maximum Likelihood Estimation of Wage Equations for Skilled Manual Employees (Trading and Non-Unionised Sector Sample) (Dependent variable is the log median wage for the majority gender in the skilled manual group)

Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)
Supervisors to staff ratio	0.52 (0.28)	-0.015 (0.23)	0.01 (0.22)	-0.035 (0.23)	-0.083 (0.23)	-0.075 (0.24)
Dummies for establishment size	Yes	Yes	Yes	Yes	Yes	Yes
Dummy for establishment in manufacturing	0.2 (0.047)	0.052 (0.042)	0.063 (0.041)	0.064 (0.042)	0.065 (0.042)	0.055 (0.042)
Proportion female in skilled manual		-0.31 (0.08)	-0.31 (0.08)	-0.31 (0.08)	-0.3 (0.08)	-0.29 (0.08)
Proportion part-time in manual		-0.67 (0.097)	-0.64 (0.096)	-0.65 (0.09)	-0.64 (0.09)	-0.62 (0.08)
Dummies for all other costs to labour costs ratio			Yes	Yes	Yes	Yes
Work intensity dummies				Yes	Yes	Yes
Effort Technology controls					Yes	Yes
Controls for other personnel policies						Yes
Weight	-0.001 (0.06)	-0.012 (0.046)	-0.024 (0.044)	-0.026 (0.044)	-0.024 (0.043)	-0.026 (0.041)
Constant	5.001 (0.19)	5.26 (0.15)	5.27 (0.21)	5.19 (0.23)	5.23 (0.21)	5.14 (0.21)
Sample size	284	284	284	284	284	284

Notes: Asymptotic robust standard errors in parentheses. Establishment size dummies include 8 dummies for if number of employees is between 25 and 50, 50 and 100, 100 and 200, 200 and 500, 500 and 1000, 1000 and 2000, 2000 and 5000, 5000 and 10000 respectively. Effort technology controls include a dummy for other benefits for skilled manual, the proportion of non-redundant dismissed employees and the proportion of sanctioned employees due to disciplinary reasons in the previous year. Other personnel policies controls include dummies for merit pay for skilled manual and for whether all employees are under appraisal for promotion and pay rises. A generalised Hausman test cannot reject the null that the coefficient of the supervisor to staff ratio in model (6) and in model (2) where no controls for effort intensity, effort technology and other motivation devices are included, are equal.

Chapter 4
Is the Minimum Wage Efficient? Evidence of the Effects of the UK National Minimum Wage in the Care Homes Sector

4.1 Introduction

An overview of the main features and stylized facts of the labour market as indicated by empirical evidence suggests that the competitive (neoclassical) model cannot explain many of the observed phenomena (Bhaskar, To and Manning 2001, Manning 2003). The same seems also to be the case in particular in low wage labour markets (Card and Krueger 1995), the operation of which consists the main focus of this thesis.

The central premise and hypothesis of the thesis is that efficiency wages considerations may be particularly valid in low wage labour markets, which further implies that efficiency wages theory can offer valuable insights on how these labour markets operate.

The failure of the competitive model to reconcile with empirical evidence produced by studies that focus on low-wage industries is better demonstrated by recent findings on the economic effects of minimum wages (Card and Krueger 1995, Dolado et al. 1996, Brown 1999, Dolado at al 2000), a topic on which the competitive model generates some unambiguous predictions, as the one that employment of covered workers falls as a result of the policy. This latter hypothesis is one of the most heavily researched questions in the field of economics and still generates considerable debate between economists (Machin, Manning and Rahman 2003).

The combination of the above limitations of the competitive model and of the evidence that supports features of efficiency wages (Holzer, Katz and Krueger 1990, Krueger 1991) in low-wage labour markets provide the main motivation for the theoretical model developed in chapter 2,[134] which generate some predictions-as the one that the increase in the minimum wage may have a moderate negative or no effect on employment of affected workers-which seem to reconcile with recent empirical findings in the field.

However, in order to further demonstrate the validity of the hypothesis that efficiency wages may particularly relevant for low-wage labour markets, in chapter 3 we offer an attempt to empirically test the hypothesis that low-wage workers may be paid efficiency wages, as it is generally agreed between labour economists (Rebitzer 1995, Manning and Thomas 1997, Autor 2003) that there is no strong evidence supporting the efficiency wage story in the labour market in general.

The lack of strong evidence in support or against the efficiency wage theory is mainly due to problems that make the empirical testing of efficiency wages particularly vexing. Our analytical discussion in chapter 3 suggests that different empirical methodologies have different qualifications and limitations, and that irrespective of the methodology used, existing studies fail to provide convincing evidence in support of efficiency wages (Manning and Thomas 1997).

[134] The theoretical model of chapter 2 is also motivated by theoretical limitations of the seminal efficiency wage model of Rebitzer and Taylor (1995), that have been used to predict the economic effects of minimum wages.

The methodological approach used in our empirical testing of efficiency wages presented in chapter 3 is based on the investigation of the prediction of the "shirking" (Shapiro and Stiglitz 1984) and "gift-exchange" (Akerloff, 1982) models of efficiency wages that in equilibrium there is a trade-off between wages and supervision, everything else kept constant.

One of the main problems of empirical studies in labour economics but also of studies of efficiency wages in particular is the endogeneity of key causing variables (Angrist and Krueger 1999). This problem seems to be equally vexing across different methodologies used to test efficiency wages.

In particular, an overview of the empirical literature of studies that test efficiency wages by testing the hypothesis of a wage-supervision trade-off suggests that it is quite difficult to overcome the endogeneity problem successfully and that is why there have been very few studies that manage to address the problem (Groshen and Krueger 1990, Krueger 1991, Rebitzer 1995) , for example by using a valid instrument for the causing variable of interest (in this case supervision intensity).

In our analysis of chapter 3, because of the lack of a valid instrument for supervision intensity, we adopt a strategy which is based on using the different theoretical models in the literature that explain the relationship between wages and supervision in order to predict the direction of the endogeneity bias and to identify the omitted variables of interest. After the identification of the main omitted factors our next consideration is to try to control for the main confounding variables in order to identify the true relationship between wages and supervision. Based on the observed direction of the bias and the significance of controls for confounding variables, this strategy enables us also to sort out alternative theoretical explanations of the wage supervision trade-off.

Our findings seem to support the hypothesis that wages and supervision are effort regulating devices in the case of unskilled manual workers. This evidence may be viewed as indirect evidence of wage effects on workers' productivity, one of the main tenets of efficiency wage theory. Although this strategy seems to produce some conclusive findings, it does not allow us to consistently identify the magnitude of the wage-supervision trade-off.

In this chapter we exploit the ideal research design provided by the 1998 introduction and 2001 increase of the UK National Minimum Wage (NMW henceforth) in order to identify the relationship between wages and supervision and to further test the validity of efficiency wage theory.

The data used were drawn from two before and after surveys conducted in the UK residential care homes industry, one of the sectors with the lowest pay in the UK economy, where one expects that the minimum wage is binding.

The identification strategy used, under this research design, is based on the implementation of the difference in differences methodology, which under reasonable conditions generates robust results of the causal effects of the treatment (Meyer 1995, Angrist and Krueger 1999) (here the Minimum wage introduction and increase) on the outcome variables of interest (supervision intensity).

In general, the introduction or increase of a minimum wage provides an ideal setting for testing efficiency wages, as the essence of efficiency wages is that above market clearing wages generate gains in terms of employees' productivity.

Another qualification of the empirical setting we use is that it closely resembles our theoretical setting in chapter 2, where we particularly look at the effects of an exogenous wage increase generated by the introduction/increase in the minimum wage on the main outcomes in the low-wage labour market including supervision, under an efficiency wage environment.

Therefore, the research design also provides us the opportunity to test the validity of the theoretical model of chapter 2 as well as the central tenet of the thesis that efficiency wages may be valid in low-wage labour markets where the minimum wage is particularly binding.

Furthermore, testing also the rest of the predictions of efficiency wages models, some of which are also generated from our theoretical model, regarding the effect of minimum wages on wages, employment, prices, profits, as well as other outcomes provides a stronger test of the validity of efficiency wages in low -wage labour markets, compared to the case where only the effects of wages on supervision are investigated.

Looking at the effects of minimum wages on the main labour market outcomes is also an attempt to present a more complete picture of the effects of the UK National Minimum Wage, which may be also used to evaluate the validity of the main theories that have been used in the literature to analyze the economic effects of minimum wages.

In summary our findings have as follows: we find a sizeable effect of the 1999 National Minimum Wage introduction and 2001 increase on wages of care homes from the south coast of England but we find some moderate negative effects on employment for the 1999 introduction and no employment effects for the 2001 increase. Our empirical analysis further suggests that the minimum wage increased the price of care homes services in 2001, in contrast to 1999 where prices were not affected, as suggested by previous findings (Machin, Manning and Rahman 2003), and didn't have any impact on profits of care homes in both the 1999 and 2001.

Furthermore, as far as any longer run effects of the minimum wage is concerned, we find no effects of the minimum wage introduction and subsequent increases on the skill composition of workforce and on capital/labour ratio. We also find some evidence of moderate output reduction to be the case after the 1999 National Minimum Wage introduction and no evidence that productivity or effort changed after the 2001 National Minimum Wage increase.

Finally and most importantly, after addressing the main empirical problems that hinder the estimation of the wage-supervision relationship, we find that the 1999 increase in the minimum wage followed by decreases in home's intensity of supervision, a finding which provides support to the efficiency wages predictions of the wage-supervision trade-off.

Moreover, after testing whether higher wages paid for themselves, we find some evidence that the wage increases resulted by the 1999 National Minimum Wage introduction, were more or less exactly offset by the fall in supervision costs, a finding which if combined with the evidence of the wage-supervision trade-off, seems to support that the minimum wage may have operated as an efficiency wage in the care homes industry. This is further supported by the fact that efficiency wage models seems to better reconcile with the overall findings and evidence from the care homes sector compared to competitive and monopsony style models.

Although, the above findings provide some support to the 'shirking' efficiency wages model we do not find any evidence that supports the 'turnover' or 'adverse selection' models of efficiency wages as we fail to find significant effects of the impact of the 1999 National Minimum Wage introduction and 2001 increase on the average experience of workforce and on average tenure as well as the quit and recruitment rates.

All in all the analysis in this chapter seems to provide some evidence in support of the main tenet of our thesis that efficiency wage contracts may be the optimal form of contracts in low-wage labour markets, and thus the efficiency wage theory could provide important insight in the operation of these labour markets.

The rest of the chapter is structured as follows: Section 2 presents a summary of the main predictions of the theoretical models used in the analysis of the economic effects of minimum wages. Section 3 summarizes the main recent studies in the topic of minimum wages in general and in the UK in particular and highlights the most important gaps in the minimum wage literature.

Section 4 and 5 present a discussion of the data and some descriptive statistics of the care homes samples before and after the 1999 NMW introduction and 2001 increase respectively and our analysis on the effects of the NMW introduction and increase on wages and employment respectively.

Section 6 presents our findings on the NMW effects on prices, profits and on long run outcomes (substitution of capital and higher skilled labour for low skilled labour) and section 7 investigates the effects of the NMW 2001 increase on labour productivity and effort as well the effects of the NMW 1999 introduction and 2001 increase on supervision intensity and other potential gains of higher wages in terms of changes in the average age/experience of the workforce, and changes in the average tenure as well as the quit and recruitment rates.

Finally section 8 provides an attempt to identify whether any of the theoretical approaches adopted in the analysis of the minimum wage better explains the overall empirical findings. Section 9 then concludes.

4.2 Review of the Theory

There are two main categories of models that have been used in order to predict the effects of minimum wages in the low-wage labour market. The key distinguishing feature of these two categories is whether employers set wages or not. The first category, has been represented by the neoclassical (competitive) model of the labour market, and its variants that account for heterogeneous workers, different product market structure, an uncovered sector etc. (Card and Krueger 1995, Brown 1999).

The second category of models in which employers have wage-setting power is analyzed by monopsony type models (models of monopsony, monopsonistic competition and oligopsony), where the term monopsony is used as a synonym to wage-setting-labour market power which stems mainly from labour market frictions (Card and Krueger 1995, Bhaskar, To and Manning 2002, Manning 2003).

The simplest variant of the neoclassical model of the labour market is one where there are identical firms that produce a homogeneous product using a neoclassical production function[135] with two homogeneous inputs (labour and capital) and firms are price takers in the product market, which is characterised by free-entry of firms.

Under this setting, the imposition (increase) of a minimum wage in the labour market will increase labour and thus production (average and marginal) cost, which will force the representative firm to cut output and thus employment in the short-run.[136] In the long-run employment will fall even more as the firm will choose also to substitute capital for labour.[137]

As employment and output fall at the firm level, industry's supply shifts up and given everything else constant industry's employment and output also fall and industry's price increases in the short-run. In the long-run, there will be entry or exit of firms depending on the relative magnitude of industry's price and firm's average cost.[138]

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135 All firms in the industry use a production function that exhibits constant returns to scale.

136 Note that the representative firm's decision making condition is to produce output up to a point where the price is equal to the marginal cost. Marginal cost increases as a result of the minimum wage increase or introduction, whereas price is unchanged and thus the profit maximising firm will choose to cut output in order to decrease marginal cost, as marginal cost is increasing in output, under standard assumptions.

137 The substitution effect does not have any impact on firm's and industry's output.

138 The result depends on the elasticity of product demand, with more elastic product demand increasing the probability of exit compared to entry in the industry. Another important factor that may affect the exit/entry outcome in the long run is whether at the same time other exogenous changes take place that cause a shift in product demand. However, in general the analysis is conducted, ceteris paribus.

In the case that price is less than average cost, then some firms exit randomly and there is a further fall in output and employment in the industry as well as a further increase in industry's price, whereas in the case of entry changes in industry's employment, output and price are in the opposite direction compared to the case of exit.

However, provided that in the long-run profits will be at the normal level, where price is equal to marginal cost and minimum average cost, industry's price is higher compared to the before the minimum wage introduction/increase long-run equilibrium, and thus industry's output and employment are lower compared to the initial long-run equilibrium.

Moreover, firm's profits fall (below normal level) in the short-run, whereas in the long-run are restored at a normal level but it is ambiguous what happens to profits in the medium run (after the increase in industry's price because of the shift in industry's supply). As the industry is consisted of identical firms the same holds for industry's profits in the short-run, medium-run and long-run.[139]

In sum, under perfect competition in both output and input markets, an increase in the minimum wage will decrease firm's and industry's output, employment and profits and will increase industry's price in the short-run, whereas in the long-run firm's and industry's employment and output fall and industry's price increases whereas profits are unchanged and it is ambiguous what happens to the number of firms.

The standard (textbook) competitive model of the labour market has been criticised of being based on a number of simplified assumptions, and thus that predictions may be

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[139] Note that this is a static model and thus strictly speaking there is no distinction between short-run and long-run. However, we adopt this distinction as we want to distinguish theoretical predictions not only between the firm and industry level but also between short and long-run.

different if some of these assumptions are relaxed. This is the main reason why we will offer an analysis of the effects of the minimum wage in the labour market, under some of the most common variants of the standard model.

The first variant that we will consider is the one that allows for a more realistic assumption of heterogeneous labour (either two types of labour skilled and unskilled or continuous type of skill, see Heckman and Sedlacek 1981 and Card and Krueger 1995). Under this extension, results are the same as in the standard model discussed above, with the only difference that in the long-run employers will substitute also high-skilled for low-skilled workers (workers with marginal product less than the minimum wage). The latter result means that employment losses of low-skilled workers may be offset by employment gains of high-skilled and thus total employment may not change after the minimum wage increase. However, under standard assumptions, employment and wages of high-skilled workers rise, whereas employment of low-skilled falls and total employment falls (Brown 1999).[140]

In the model where human capital (an amalgam of factors as schooling, experience, motivation and ability) is continuously distributed across workers an increase in the minimum wage has two effects: truncates the human capital distribution at a lower point and thus price workers of lower human capital out of jobs, and shifts the distribution to the right increasing the average price of human capital. Finally, the demand for total human capital at the firm and in turn at the industry level falls (Card and Krueger 1995).[141]

[140] This is the case in the discrete-type of labour model (Card and Krueger 1995) as long as the cross-elasticity of capital and low-skilled labour is non-zero.

[141] Firm's output depends on efficient labour input i.e. the sum of the human capital endowment of all employees. Because of the increase in the average price of human capital efficient labour input falls. Although,

Another interesting extension of the neoclassical model is one that allows for product market power.[142] The main difference of this variant compared to the simple, benchmark model is that the individual firm has some discretion over product price. Predictions, under this framework are not different qualitatively, compared to the standard model, as adjustments at the firm level will be, at least qualitatively, similar to adjustments at the industry level in the basic model. Marginal and average cost increase for all firms in the industry and each firm will pass on some of the costs to price which will further reduce output and employment at the firm level.

At the industry level, where all firms increase prices at the same time, the fall in output is smaller (Card and Krueger 1995). If one assumes also free entry then profits will be zero in the initial long-run industry and firm equilibrium and thus the change in the number of firms will be indeterminate as it depends on the relative magnitude of price and average cost at the firm level.[143] Finally profits fall in the short run as a result of the minimum wage increase and if one assumes free entry then profits are constant in the long-run but we don't know what the change in profits will be in the medium run.

The final extension of the neoclassical model of the labour market we will consider is one that allows for an uncovered sector.[144] The increase in the minimum wage causes ex-

efficient labour falls, the number of employees may rise if human capital endowment of employees falls sufficiently. The minimum wage imposes a floor to the fall of human capital as human capital endowment determines the marginal productivity of a worker and thus it is quite unlikely that the fall of efficient labour will be achieved by an increase in the number of employees induced by a sufficient fall in the human capital of employees.

142 This may be the case for many reasons as imperfect information, heterogeneous consumers' preferences and mobility costs.

143 In this case firms are not identical and thus if exit is the case it will not be random, as firms that exit will be those for which the increase in average cost exceeds the increase in price.

144 The main reason we are presenting this is for completeness as this kind of models used to be quite popular in the minimum wage literature up to the early 1990s. Our empirical analysis that follows is concerned with

cess labour supply[145] in the covered sector. The uncovered sector wage adjusts to equate demand in the covered sector and supply of those that are willing to work at the uncovered sector wage and haven't been hired in the covered sector. However, uncovered sector employment only partially offsets the loss in employment occurred in the covered sector (Welch 1974, 1976, Mincer 1976 and Gramlich 1976).

In sum, models that allow for an uncovered sector (again employment is homogeneous and the two sectors are identical initially) regardless of the impact of the minimum wage on the uncovered sector, they generate the same predictions with the standard model for the uncovered sector with main prediction that the minimum wage leads to a decline in covered sector employment, with the only difference being the fact that the uncovered sector may dilute any negative employment effects of the minimum wage.

In summary, although the setting may be different between the simple competitive model and its variants, the predictions are qualitatively the same with the central feature of all models being that employment of affected workers is unambiguously decreased as a result of a minimum wage increase-introduction.

As suggested above an alternative type of models used to analyse the effects of minimum wages are models in which employers have some discretion over wages and thus some wage-setting power.

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an economy wide minimum wage introduction and increase and models that allow for an uncovered sector may seem irrelevant in the case of the UK NMW. However, these models may still be useful in analysing the case of an economy-wide minimum wage, as higher wage sectors that are covered but not affected by the minimum wage can substitute for the 'uncovered' sector.

[145] The excess labour supply is consisted by displaced workers as well as new participants.

In general, models of wage-setting power lead to more plausible and less elaborate explanations of many labour market phenomena (Card and Krueger 1995 and Bhaskar, To and Manning 2002). Wage-setting power is seen as the result of important labour market frictions as for example imperfect information, heterogeneous workers' preferences or mobility costs that can explain why the elasticity of labour supply at the firm level is finite (Manning 2003).

The simplest case of models where employers have wage-setting power, is the case of a static natural monopsony (Robinson 1933, Charles 1974), where there is a unique employer in the labour market. We will initially assume for simplicity that the monopsonist operates in a perfectly competitive product market.[146] Under this framework an increase in the minimum wage, decreases the marginal cost of labour[147] in the short-run and thus employment and output increase at the firm level. In the long-run, employment will be increased even more as because of the fall of the relative costs of labour, the monopsonist will substitute labour for other inputs (capital for example).

At the industry level employment and output are increased and industry's price falls, in the short run. However, although marginal cost of labour falls, average cost of labour rises as an effect of the minimum wage and given also that industry's price falls, under free

[146] In particular, for the shake of simplicity, we analyse the extreme case where there are many firms in the product market and each one is a monopsonist in the input market. This may be the case if there are many firms that compete in the product market but each firm operates in an isolated town environment and is the unique employer of low-skilled labour.

[147] Note that this holds for a sufficiently small minimum wage increase as there is a level of the wage increase for which marginal labour cost increases and thus employment and output decrease. However, we are interested in analysing the case in which employment increases after the minimum wage increase as all predictions in the case where employment falls can be easily deduced by reversing the analysis.

entry this implies that profits fall below normal level and thus the number of firms should be decreased via exit, in the long-run.

Provided, the higher average cost of labour caused by the minimum wage increase, exit should continue up to the point where the short-run employment gains at the firm level are more than offset, so that aggregate employment falls and industry price rises by enough to restore equilibrium at a normal profit rate. In sum, under monopsony a suitably set minimum wage increases employment at the firm level, increases firm's and industry's output and decreases industry's price and profits in the short run. In the long-run, firm's exit decreases aggregate (industry) employment (the firm level employment is higher again in the long-run compared to firm employment before the minimum wage introduction) and output and increases industry's price above the initial long-run equilibrium level, whereas profits are again at a normal level.

An interesting extension of the static monopsony model is one where firms have also product market power, and thus can have a discretion over product prices. Under the case where the minimum wage increases firm's employment and output, aggregate employment and output can be also increased only when firms have product market power that allow them to sustain positive profits in the initial long-run equilibrium (Zavodny 1996). Given that the minimum wage increases average labour cost, aggregate employment and output can be increased only if industry price falls, which can be done only if firms have market power and earn positive profits before the minimum wage increase.

If firms are initially earning zero profits, an equilibrium with lower prices and higher employment is unsustainable. Firms must have enough product market power to absorb the loss in profits due to an increase in costs and a decrease in prices generated by the minimum wage introduction/increase. A minimum wage thus can raise total employment and lower prices only if there is market power not only in the labour market but also in the output market. The effect on the number of firms is indeterminate, but any decrease in the number of establishments must not offset the increase in firm-level employment if aggregate employment is to increase (Zavodny 1996).

Although, the simple static monopsony model has been validated in several concentrated markets, including nurses (Sullivan 1989) and school teachers (Landon and Baird, 1971) it does not seem to apply very well to minimum-wage labour markets which are usually characterised by many small establishments and low skill requirements.

The dynamic monopsony model, in contrast, assumes that labour market frictions may lead to an upward sloping labour supply curve at the firm level, and thus wage-setting power, making it particularly plausible in an industry with many small firms. A simple version of the dynamic monopsony model is presented by Zavodny (1996),[148] who extends the dynamic monopsony model presented in Machin, Manning and Woodland (1993) and Card and Krueger (1995), to include a product market. The predictions of this model generated are exactly the same (under both perfectly and imperfectly competitive product market) with the predictions of the static models discussed above.

As discussed above there are different sources of wage-setting power, which further lead to a different structure of the labour market under study. For example, a small number

[148] Zavodny emphasizes that her dynamic monopsony model generates the same predictions as the seminal model of Burdett and Mortensen (1998) but without incorporating an imperfect search process. Burdett and Mortensens model can be thought as a general equilibrium model of dynamic oligopsony that is very stylized but captures the most important features of a labour market with frictions (Manning 2003).

of employers that collude in the labour market can be described as a case of oligopsony, whereas the case where there is oligopsony because of horizontal job differentiation (jobs are neither inherently good or bad, but workers' preferences over them differ) and there is also free entry characterises monopsonistic competition in the labour market (Bhaskar, To and Manning 2002). For the shake of completeness we will also present predictions of this kind of models, as these models can depict a realistic view of the labour market and provide valuable insight on the economic effects of minimum wages.

The simple model we will discuss is presented in Bhaskar, To and Manning (2002) but more elaborated versions are presented by Bhaskar and To (1999) and Walsh (2003). According to this model, the source of wage setting power is workers' heterogeneous preferences over jobs, which in turn stem from the existence of moving (transportation) costs because of differential location by firms.[149] Again, under this framework labour supply at the firm level is upward sloping, and thus a minimum wage set moderately above the market wage increases employment at the firm level. However, the increasing employment effect of the minimum wage is moderated by the fact that the minimum wage increases also the wage of other firms which further implies that the labour supply at the firm level shifts to the left.

Despite the reduction in establishment level labour supply, a minimum wage set moderately above the market wage still causes establishment level employment to increase, because if all employers offer higher wages, the labour participation rate must also rise. The intuition of the changes is similar to the above (static and dynamic monopsony) models: an

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[149] In general workers preferences may not involve physical costs but also psychic costs as well.

above market minimum wage enables employers to fill some of their vacancies. Of course, employers could have chosen to raise pay on their own, but to do so would cut into their profits, because payroll for inframarginal workers rises when wages increase.

Note also that because a minimum wage will decrease profits and given that there is free entry into and exit out of the labour market, some employers will be forced to exit. The exit of firms has a negative effect on total employment through the destruction of jobs in exiting firms. Thus, the minimum wage involves two counteracting effects on aggregate employment.

Under, the more elaborate model of Bhaskar and To (1999), the sign of the net employment effect depends on the extent of distortion in the labour market,[150] with larger distortion leading to a positive aggregate employment effect of a minimum wage marginally above the unconstrained wage. However, Walsh (2003) managed to resolve the ambiguity that arises in the Bhaskar and To model (1999) and to show that the minimum wage unambiguously increases aggregate employment, under the Bhaskar and To model. Additionally, Bhaskar and To (2004) show that under a different specification of workers' preferences (Dixit and Stiglitz, 1977, style of monopsonistic competition in contrast to Salop, 1979, style adopted in their first article), aggregate employment unambiguously falls as a result of the minimum wage. Note that the above results hold in Bhaskar and To (1999), under fixed product price.[151]

[150] By the extent of distortion the authors mean the degree that the labour market structure deviates from perfect competition.

[151] Under this case exit not only reduces aggregate employment but increases employment in surviving firms, by increasing labour supply to these firms. Thus, given that prices are fixed profits are restored by exit which increases gross profits up to the point that covers the fixed cost of production.

In the case that product price varies, a higher minimum wage increases employment and output at the firm level and thus at the aggregate level (holding the number of firms constant) and given that employers operate in a perfectly competitive product market industry's price falls. On the other hand the fall in the price decreases the marginal revenue product of labour and profits and thus induces exit. Bhaskar and To (1999) suggest that the magnitude of any changes induced by the minimum wage introduction/increase as discussed above is lower when prices are free to vary.

In the case that prices are flexible and firms have some product market power an outcome where aggregate employment increases, whereas price increases as well because output falls may arise. This is explained by the degree of substitutability of inputs in production which may allow for employment to increase as a result of the minimum wage in the short-run, by substituting labour for capital, without affecting output.

As profits fall in the short-run, the number of firms is expected to decrease in the long-run which in turn leads to a fall in aggregate output[152] and therefore to a price increase. Again, aggregate employment may still increase if the short-run employment gains more are less than offset by fall in the number of firms in the long-run.[153] The intuitive explanation of the increase in the industry price, when firms have not only labour market power but also product market power is that because of the oligopolistic product market structure price is a constant mark-up over marginal cost with the mark-up being negatively

[152] Aggregate output is unchanged in the short-run after the minimum wage change because of the perfect substitutability of labour and capital that allows employers to offset the costs of the minimum wage hike without cutting employment and thus output.

[153] As discussed above Bhaskar and To (1999) provide the conditions under which this could be the case. However, based on the Walsh (2003) result aggregate employment actually unambiguously rises.

correlated to the number of firms in the market. As the minimum wage hike decreases profits and induces exit, the mark-up and thus product market power of surviving firms increases as there are less firms in the industry. The result of increased product market power is higher prices and lower output.

The latter prediction, that under labour and product market power and provided a sufficient degree of substitutability of factors, aggregate employment rises, whereas aggregate output falls and industry's price rises is quite interesting as it reconciles with empirical evidence that the increase in the minimum wage increased employment but also prices (Card and Krueger 1995).[154] This kind of evidence made many labour economists sceptic as whether employment increases suggested that the labour market is monopsonistic, who they mainly tended to explain the observed findings as a result of unobserved demand shock.

In our previous discussion we emphasised that there are various sources of labour market power with one of the main being imperfect information. Imperfect information (mainly on workers' side) may give rise to an upward sloping labour supply at the firm level and thus lead to a positive minimum wage employment effect, as for example in the case of the Burdett and Mortensen (1998) model.

Under certain conditions imperfect information about worker's actions and type (thus imperfect information on the employer side) may be a reason why employers may pay efficiency wages on the job (Akerloff and Yellen 1987, Weiss 1990). Under efficiency

[154] This may be also the case in the static monopsony model, under a competitive product market, when although aggregate output falls and price increases in the long-run, aggregate employment may increase because in the long-run plabour is substituted for other inputs without affecting output.

wages, an increase in the minimum wage may increase employment as the higher wage contributes also to revenues (Manning 1995). Models of efficiency wages that have been used in the analysis of the minimum wage include Calvo and Wellisz (1979), Rebitzer and Taylor (1995), Manning (1995), as well as our extended version of the Rebitzer and Taylor model with endogenous supervision intensity presented in chapter two.

Under, the efficiency wages environment described by our theoretical model in chapter two, workers are homogeneous and employers use a combination of an above market clearing wage and supervision to prevent shirking.

In this case again labour supply at the firm level is upward sloping as employers should increase the wage in order to hire an extra worker because an increase in the number of workers decreases the probability of detection of a shirker and thus increases propensity to shirk, given everything else constant.

An increase in the minimum wage has an ambiguous effect on employment at the firm level. We show that there are two counteracting employment effects of the minimum wage. On the one hand the higher wage decreases the propensity to shirk and thus enables the supply constrained firm to hire more workers, but on the other hand the lower propensity to shirk enables employers to save monitoring costs by employing less supervisors, which further decreases employment as with less supervisors less workers can be monitored. We further demonstrate that, if both effects are present, employment is unchanged for a minimum wage set marginally above the equilibrium wage, and employment falls if supervision is fixed, as predicted by the Rebitzer and Taylor (see table 4.1 for a summary of the theoretical predictions).

4.3 A Brief Review of the Minimum Wage Literature

The economic effects of minimum wages is a heavily researched issue that generates much controversy, especially after the striking findings of Card and Krueger (1995) that cast doubt on the orthodox view of the effects of the policy on employment. Although, the debate on the issue remains, one of the points of agreement among economists in the topic of minimum wages is that more evidence is needed to inform the debate and improve insight (Card and Krueger 1995, Dolado et al 1996, Dolado et. al 2000).

It is true that the vast majority of empirical evidence on the economic effects of minimum wages is from the US labour market and little is known about the effects of the minimum wage policy in other labour markets (Dolado et al 1996, Dickens Machin and Manning 1999, Lemos 2002).

There are many economists among those who believe that more international empirical work could cast much light in many fields of labour economics and in particular in the topic of minimum wages (Hamermesh 2002).

As far as the UK is concerned, Dickens, Machin and Manning (1999) investigated the economic effects of Wages Councils and their 1993 abolition on economic outcomes. Since the abolition of Wages Councils in 1993 there was no minimum wage in the UK (except of the agricultural sector), but the labour party which was reelected in the government in 1997 committed to introduce a minimum wage. A UK wide (national) minimum wage was legislated with effect from April 1999, fact which provided a unique setting for the investigation of the economic effects of the minimum wage introduction in a previously unregulated labour market.

Machin, Manning and Rahman (2002, 2003) exploited this unique setting and conducted two surveys in order to collect primary data before and after the introduction of the UK National Minimum Wage (NMW henceforth) from firms in the residential care homes industry, one of the sectors with the lowest wages in the UK. The data collection enabled Machin et al. to implement what is now considered a standard technique in the empirical literature of minimum wages (Card and Krueger 1995). Their main conclusions were that the minimum wage introduction caused a substantial increase in wages and significantly compressed the wage distribution in the care homes sector but had only moderate employment effects.

Moreover, Machin and Wilson (2004) used additional data (collected by the Centre for Economic Performance) to that of the Machin et al (2003) study from residential care homes from the south coast of England, to investigate the effects of the 2001 UK NMW increase, the largest increase in minimum wage rates since the introduction of the policy. In particular, Machin and Wilson used the data from the before and after 1999 NMW introduction on care homes throughout the UK (used in the Machin, Manning and Rahman study) and the additional data from the before and after 2001 NMW increase on care homes from the south coast of England to implement the standard difference-in-differences technique and investigate the effects of the 1999 introduction and 2001 increase in UK NMW on wages and employment.

Additionally, Machin and Wilson (2004) also address the effects of minimum wages on closures of south coast care homes between the period before the 1999 introduction and before the 2001 increase. The results produced by Machin and Wilson (2004) study show sizeable wage effects and some evidence of employment reductions but their analysis suggests that the 1999 introduction of the NMW had no effect on home closures.

The main objective of this chapter is to exploit the unique research design provided by the UK NMW 1999 introduction and 2001 increase by using the south coast care homes data (which were kindly provided by Steve Machin and Joanne Wilson) to identify the relationship between wages and supervision and to test the validity of efficiency wages theory.

Another objective of this chapter is to use the care homes data in order to reproduce the Machin and Wilson work but also to extend it in order to investigate the effects of the NMW introduction and increase on other outcomes such as prices, profits, effort and productivity, as well as looking for other longer run adjustments such as factors substitution. This is because another gap than the lack of non-US evidence in the minimum wage literature is the lack of sufficient evidence of the effects of minimum wages on other outcomes than employment and the wage distribution and particularly on the effects of minimum wages in the long-run (Brown 1999).

The investigation of any minimum wage effects on prices, profits, and long-run outcomes as the exit and entry of affected firms could provide a more complete picture of how low-wage labour markets operate and especially on the effects of the policy on employers as most of the existing research has focused on minimum wage effects on affected workers (Card and Krueger 1995). Moreover, as suggested by the review of the theory of the minimum wage of the previous section, theory generates both short run and long run predictions and thus it is important for empirical studies to distinguish between the two.

In particular, Brown (1999) indicates that the long-run effects of minimum wages consist the larger and most important gap in the minimum wage literature. This is the case for many reasons as for example there is a stunning lack of credible studies or even attempts on the effects of minimum wages in the long run (Brown 1999). However, the main reason why this remains an important gap is that it may provide a potential explanation of the puzzle that recent estimates of minimum wage employment elasticities are small. As suggested by theory the demand for labour is more elastic in the long run, where firms may downsize or exit and potential entrants may be deterred. Moreover, most of the empirical studies that investigate the employment effects of minimum wages focus on sample of firms that continue operation and do not look for any exit that may have taken place as a result of the policy (Rebitzer and Taylor 1995).

In general exit or entry effects cause discontinuous changes in employment and thus should be seriously considered (Hamermesh 1992). This is another reason why it is important to look for evidence on other longer run outcomes.

We do not know many studies that look also on other possible adjustments to the policy other than employment (Card and Krueger 1995). Card and Krueger (1995) and Brown (1999) devote some of their analysis in investigating or reviewing the minimum wage effects on prices, profits, fringe benefits and stock value of employers of low-wage workers among other outcomes but their main conclusion is that more evidence is needed to provide a more clear picture.

Although some evidence has been produced on any other short run adjustments the main lack of evidence as suggested above has been on the effects of the policy on exit and entry of firms in the long run. Indeed we know very few studies that address these issues and their characteristic is that all studies devote only a minor part of the analysis on these hypotheses.

Zavodny (1996) addresses this particular question using data on drinking and eating places, retail trade and clothing stores the two largest employers of minimum wage workers in the US and thus the most heavily affected sectors. The main findings of the study suggest that the minimum wage had a positive effect on the number of firms in the affected sectors.

On the other hand Waltman, Mcbride and Camhout (1998, 1999) examine the same hypothesis using data on the aggregate rate of business failures. This study finds no effect of the minimum wage on business failures, but suffers from many econometric problems as suggested by Taylor and Arnold (1999). Moreover, Alpert (1986) also examines this issue together with other issues using US quarterly data on restaurant failures. Alpert finds no evidence that restaurant failures have been adversely affected by the minimum wage

Card and Krueger (1995), also investigate a similar hypothesis by considering the effects of minimum wages on Mcdonald's fast-food restaurants openings during the years 1986 and 1991 and in contrast to conventional wisdom they find positive but not statistically significant effects of minimum wages in restaurant openings, suggesting that the minimum wage does not seem to have a strong (negative or positive) effect on openings in the fast-food industry. All, the above evidence reviewed are from the US and indeed we know only two recent studies or empirical attempt to identify exit or entry effects of the minimum wage policy in Europe.

This evidence is provided by Machin, Manning and Rahman (2003) (MMR henceforth) and Machin and Wilson (MW henceforth) who both exploit the fact that a nation wide minimum wage has been introduced in April 1999[155] and has been increased several times since then with the bigger increase being the one that took place in October 2001.[156]

MMR (1999) used the data collected from a sample of residential care homes throughout the UK in order to investigate also the impact of the minimum wage on the probability of closure across homes as well as in the closure and opening rate across counties, between July 1998 and May 1999, but they fail to find any significant effects. However, they suggest that the timing of the post NMW introduction survey may not allow for the identification of long run adjustments to the minimum wage as that of exit and entry.

MW (2004) offer a more credible attempt to investigate the relationship between the impact of the minimum wage and home closures using a sample of care homes from 8 south coast UK counties between the July 1998 and just before October 2001 NMW increase, a period that possibly allows for the identification of any minimum wage effects on exit.

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[155] The UK National Minimum Wage has been set at £3.6 for those aged 22 and over (the adult rate) and at £3.00 for those between 18 and 21 years old inclusive (the development rate). Those below 18 were not covered.

[156] The development rate has been increased to £ 3.20 in June 2000, whereas the adult rate increased again to £ 3.70 in October 2000. Since then, both rates have been increased every October with the biggest increase to date the one that took place in October 2001 where the adult rate increased from £3.70 to £4.10 and the development rate from £3.20 to £3.50, a 10.8 % and 9.3% increase respectively(Metcalf 2004) (The increase in the development rate in October 2004 from £3.80 to £4.10 per hour is the same as that in 2001 in absolute figures but proportionately lower). The most recent increase in the NMW has been in October 2004 where the adult and development rates have been increased from £4.5 to £4.85 and from £3.80 to £4.10 respectively and a NMW introduced for those aged 16 and 17 (above compulsory school leaving age) at £3.00 per hour. Moreover, the Low Pay Commission recommended an increase in the adult rate from £4.85 to £5.05 and to the development rate from £4.10 to £4.25 effective from October 2005. For an overview of the history and a review of the evidence produced up to now on the effects of the UK NMW see Metcalf (2004). MMR provide also a good background of the NMW policy (2003).

The main finding of MW, as also discussed above, is that they fail to find any systematic relationship between home closures and the NMW introduction.

4.4 The Data and Descriptive Statistics

4.4.1 Survey Design

Our analysis is based on information on all workers in each home and on home characteristics from a sample of care homes in the South Coast of England, collected by two surveys, the one conducted before and after the 1999 NMW introduction and the other before and after the 2001 NMW increase.

The data were collected through the Centre for Economic Performance (CEP) in LSE, by mailing a survey questionnaire to the manager of each care home. Both surveys were implemented using lists of homes from the Yellow Pages Business Database, but the before and after 1999 NMW introduction focused on the whole UK population of residential care homes in July 1998 and in May 1999,[157] whereas the before and after the 2001 NMW increase survey focused on the population of homes from the South Coast UK counties in August 2001 and February 2002.[158]

157 However, as also mentioned above, our analysis on the effects of the 1999 NMW introduction is based on a subset of this data set including only homes from the South Coast of England, see MW (2004) for a detailed discussion.

158 The former population was around 11, 000 and the latter around 2,500 care homes. In fact there was another survey implemented in the population of South Coast care homes around the window of the 1992 elections, since the Labour Party had committed to introduce a minimum wage if they were elected. The fact that they were not elected meant that data could not be used for the purpose of evaluating minimum wage effects. However, the after 1992 elections survey implemented anyway, as the data considered useful for the study of the wage structure of the Care homes sector (Machin and Manning, 2002), and in order to look at wage and employment changes during a period when the minimum wage was not introduced (MMR 2003). See also MMR (2003) for a more detailed discussion of the 1999 survey design and data collection and MW

The questionnaire included questions about manager's information and attitude towards the NMW,[159] as well as questions about the home ownership type (private, local authority, etc.), whether the home is part of larger organisation, the number of registered beds, the number of residents, etc. Managers were also asked to provide data on job title, sex, age, length of service, possession of a nursing qualification, weekly hours and hourly wages for all workers in the home.

All (three) surveys achieved a reasonable response rate for a mail survey (around 20%).[160] Note that as in MMR (2004) in the cases where there was missing information on hourly wages and weekly hours we impute them using the home average, but both statistics with imputed and non-imputed are reported. MMR and MW provide evidence and discussions that seems to support the fact that all (three) samples of care homes were

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(2004) for a further discussion of all three surveys.

159 These kind of questions differed between the before and after the NMW introduction and increase for apparent reasons.

160 The care homes samples of the before and after 1999 surveys included 1866 and 2142 homes respectively, whereas the 2001 before and after survey samples included 411 and 333 homes respectively. MMR apply their analysis also in two subsets of the whole 1999 care homes sample: the balanced panel of homes which includes 641 homes that were surveyed both before and after the 1999 NMW introduction and a subset of the balanced sample which excludes homes with lots of missing information, i.e. homes in which more than half of information on hourly wages and weekly hours is missing, and includes in total 615 homes. The South Coast subset of homes in the MMR sample, on which our analysis focuses includes 548 homes prior to the NMW introduction and 579 after the introduction, and the balanced sample includes 195 homes but no other subset of the balanced sample is produced, as there are no South Coast homes with more than half workers information missing. Note that there is a difference in the size of the 1999 balanced sample of South Coast carehomes included in our analysis and that of MW, who report that their wage and employment change regressions were based on a sample 181 homes, where no controls were included. This is why we also try to check the matching of homes included in the before 2001 NMW increase sample with homes included in the after 2001 sample. We find that the balanced sample of homes seems to be consisted of 152 homes in contrast to MW who report 173 homes in their wage change regressions and 193 homes in their employment change regressions when no controls were included. Finally, as the 2001 balanced sample included also 22 homes with more than half workers information missing we also present survey statistics for a subset of 130 homes from balanced sample which excludes homes with lots of missing information on workers' hourly wages and weekly hours.

representative of the corresponding population in terms of workers' wage, age, hours and tenure[161] (see Woodland, 1993, MMR 2003 and MW 2004 for a detailed discussion).[162]

4.4.2 Descriptive Statistics

The two survey statistics that are presented in table 4.2 and table 4.3 (see tables section at the end) summarise the main features of the whole sample of care homes before and after the 1999 NMW introduction and the 2001 NMW increase as well as the main characteristics of the balanced sample of homes, which includes only homes that were surveyed both before and after the Minimum wage introduction/increase. The vast majority of care homes in all samples is consisted of private and independent establishments with very few homes being voluntary or owned by local authority and a part of a large organisation.[163]

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[161] The same holds for the 1999 South Coast care homes sample used in our analysis, which is a subset of the whole 1999 care homes sample used in MMR's analysis, as sample statistics of wages, hours, age and tenure between the two samples are very similar.

[162] As suggested by MMR (1999), the data were punched in the computer by various students, and that is why we had a closer look for any errors in the variables of interest. In particular, MMR and MW use two different measures for the impact of the minimum wage: the proportion of workers whose wage is affected by the minimum wage (covered workers that are paid an hourly wage that is below the age specific minimum rate before the NMW introduction and increase) and the wage gap (the proportional increase in the weekly wage bill at home if the wages of workers affected is increased to meet the age specific minimum wage). We calculate the proportion of affected by the minimum wage workers as the ratio of the number of workers with information on whether they are covered and affected (i.e. whether they are paid below their age-specific minimum rate) to all workers with information on whether they are affected or not by the NMW. The same approach is used in the calculation of the sample values of the wage gap variable. A comparison of the minimum wage impact variables calculated as described above with those calculated by MW (which were included in the data sent to us by the authors), seems to suggest that the former take into account more information and that is why their values are noticeably different than the latter (for example we account those that are not covered, i.e. those below 18 years old and those paid above the adult rate as not affected even in the case where there is not information on their hourly wage and age respectively).

[163] In particular 481 out of 548 homes in the before 1999 NMW introduction sample are private and only 65 are part of a large organisation. Moreover, 489 out of 579 homes in the after 1999 NMW are single independent establishments and 499 are privately owned. The 1999 balanced sample includes only 25 homes that are not privately owned and 19 that are part of large organisation, out of 195 care homes included in total. Similarly, 368 out of 411 homes in the before 2001 sample are privately owned and only 60 are part of a large organisation. The after 2001 NMW increase sample includes 45 non-privately owned homes and 281 independent establishments out of 333 care homes in total. Finally, the 2001 balanced sample includes only 14 non-private homes and only 18 homes that are part of a larger organisation, out of 152 observations

As presented in tables 4.1 and 4.2, the main sample statistics are fairly similar between the whole sample and the balanced samples of homes in both the 1999 and 2001 before-after surveys, suggesting that the balanced sample is representative of the whole sample and the population of care homes as a whole.

The two tables clearly reveal some of the main characteristics of the care homes sector. Firstly, the average hourly wage is quite low and in particular slightly above the adult rate both in the period before the NMW 1999 introduction and 2001 increase,[164] a fact which suggests that the sector is expected to be heavily affected by the minimum wage introduction and increase.

The fact that the vast majority of employees at home are female, that the average number of hours is below thirty and that care assistants is the principal occupation, as well as the fact that a very small fraction of employees has a nursing qualification[165] seems to provide further support to the argument that minimum wage effects on care homes outcomes are expected to be substantial. This is actually the case because low-skilled, female and part-time workers form the majority of low-wage workers in the economy as a whole (Low Pay Commission 1998, Metcalf 1999). Moreover, as it is also suggested by the New Earnings Survey (MMR 2002) the occupation of care assistants is probably the lowest paid occupation in the UK (MMR 2003).

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in total.

[164] The average hourly wage is around £4 before the 1999 NMW introduction with the introductory level of the adult national minimum rate being £3.6, whereas the same statistic is around £4.7 before the 2001 increase with the 2001 adult rate being £4.1.

[165] Nursing qualification is the only relevant qualification in the care homes sector. Note that the proportion of workers at home with a nursing qualification is the only statistic that differs significantly between the 1999 and 2001 surveys.

Other dominant characteristics of the 1999 and 2001 care homes samples is that the representative home is small in size both in terms of the number of employees and the number of residents (the number of employees ranges between 14 to 16 on average per home in both surveys), the majority of workers are older on average (the average age at home is around 40 years old in both surveys) and that a significant proportion of residents have their fees paid by local authorities (between 45 and 50% in both surveys), with the latter observation suggesting that it is even more likely to find minimum wage effects in the industry as the price of services for those residents are capped by local authorities and thus the ability of home owners/managers to pass some of the NMW costs on prices is expected to be quite limited (MMR 2003).[166]

In their earlier paper MMR (2003) suggested that the fact that the average home is small in size not only makes feasible the collection of good data on all employees but also implies that monitoring problems are not expected to be severe. This may further suggest that any efficiency wages considerations arising from imperfect monitoring are unlikely to be valid in the sector.

Although home size may be an indicator of monitoring problems, it is a good proxy for monitoring intensity only if there is only one employee (probably the home owner) engaged with monitoring activities, which is unlikely to be the case, as the nature of the business is such that home operates twenty four hours a day and seven days per week which

[166] MMR (2002, 2003) and MW (2004) provide information that the level of the local authorities security funding was not increased to meet the National Minimum Wage increase in 1999 which further implies that home owners-managers couldn't pass on the costs to residents (at least those that have their fees paid by local authorities) by setting higher prices. This conjecture is further supported by a comparison of the average weekly price of bed in the before and after 1999 NMW introduction in the whole and balanced samples which indicates no significant change in care homes prices.

makes it impossible for a single owner to be physically present and monitor employees all the time. Therefore, a better measure of monitoring intensity (or observability of workers' effort), than the inverse of employment at home, could be the number of managerial workers per non-managerial employee, the most popular proxy of monitoring intensity in the literature (Odiorne 1963, Gordon 1990, 1994). The fact that supervision intensity may be better approximated by the ratio of managerial to non-managerial employees than the inverse of employment is also supported by the scatter plots of the number of non-managerial and managerial employees of the whole care homes samples before the 1999 NMW introduction and before the 2001 NMW increase presented in figures 4.1 and 4.2 respectively. As indicated in the figures, although there are homes with no or one manager only, in a significant share of the sample there are more than only 1 manager at home.[167]

Moreover, as presented in tables 4.2 and 4.3, there is approximately one supervisor[168] for every nine employees in the 1999 sample of homes on average and around 1 managerial employee for every eleven non-managerial employees on average in homes in the 2001 sample.

These averages, combined also with the "twenty four-seven" nature of the business, as well as the fact that the quality and not only the quantity of monitoring is important in order to tackle agency problems (Kruse 1992, Brunello 1995) may suggest that imperfect monitoring considerations may still be valid, despite the small size of the average home.

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[167] This holds more strongly for the 2001 than the 1999 sample of care homes.

[168] As managerial employees are classified employees with job titles: manager, home owner, matron, deputy matron, assistant matron, deputy manager and assistant manager.

Other considerations for the relevance of efficiency wages in care homes could be suggested by the quite high turnover rate.[169]

Furthermore, differences in average hourly and weekly wages between before and after the NMW introduction and increase seem to further indicate that, as expected homes in the sample have experienced significant increases in wage costs.[170] In particular information from the balanced sample of homes suggests that hourly wage was increased on average by 12 and 15 pence after the 1999 NMW introduction and the 2001 increase respectively (with or without imputed information).[171]

Moreover, as presented in table 4.2 the survey statistics (for the balanced panel) do not seem to differ significantly between the pre and post 1999 introduction period, except of hourly and weekly wage (with or without imputed information), and of the ratio of managerial to non-managerial employees at home. The noticeable increase in supervision intensity in the after 1999 NMW introduction (in the balanced sample)[172] can be better explained by looking at the changes in the cross section distribution of the number of managerial and non-managerial staff between the before and after the NMW introduction. Figures 4.3 and

[169] Sample averages of the quit and recruitment rate for both the before the 1999 and before 2001 surveys, on average 13% of staff has left and the same proportion was recruited the last three months from the time of each survey. These turnover figures may be considered as quite significant considering the short period for which the relevant information is reported.

[170] This issue is analysed further in the next section where more measures of the 'bite' of the minimum wage introduction and increase on the distribution of wages are presented.

[171] This means a 2.8% and a 3.4% increase in average hourly wages for the 1999 introduction and the 2001 increase respectively. Note that our figures for the 1999 introduction differ significantly from those presented in MMR (2003), where the authors report an increase in hourly wages of 24 pence or 6% for the sample of care homes throughout the UK. Another interesting observation is that the absolute or proportionate change in the average hourly wage is not found to be higher for the period of the introduction compared to that of the NMW increase, as it would be expected.

[172] For the whole sample also the number of beds and number of residents seem to differ significantly between the pre and post NMW introduction.

4.4 indicate that the distribution of the number managerial staff across homes remained fairly the same after the NMW introduction, whereas in figures 4.5 and 4.6 we observe that the distribution of the number of non-managerial staff becomes more skewed to the right after the introduction of the NMW.

Comparisons of pre and post survey statistics for the 2001 NMW increase (from the balanced panel of care homes) suggest that again the most heavily affected outcomes in the sector are again hourly and weekly wages as well as the proportion of care assistants, average weekly price of bed[173] as well as the proportion of residents whose fees are paid by local authorities and the ratio of managerial to non-managerial employees.[174] In contrast to the 1999 introduction, supervision intensity in this case decreases after the NMW increase, a result which can be explained by the fact that the distribution of the number of non-managerial staff seems less compressed after the increase compared to before the increase, whereas the distribution of the number of managers becomes more skewed to the right and more compressed after the 2001 NMW increase (see figure 4.7, 4.8, 4.9, and 4.10).

The increase in hourly wages combined with the fall in the number of managerial relative to non-managerial employees and the proportion of care assistants at home (who are low-skilled, non-managerial employees), may further reconcile with the prediction of the shirking models of efficiency wages (Shapiro and Stiglitz 1984, Georgiadis 2001) that wage increases lead to relaxation in monitoring intensity.[175]

[173] As discussed in one of the following sections although prices remained capped by local authorities in the period before and after 1999, they were not capped for the period around the 2001 NMW increase.

[174] The same seems to be the case for the whole sample of care homes, except of the fact that the supervisor/supervisee ratio remains unchanged, whereas the number of beds differs noticeably between the pre and post increase survey.

[175] However this prediction is generated for given everything else, which is not the case for the descriptive

In general indications of significant wage effects of the minimum wage is a necessary condition, as also suggested by MMR (2003) in order to proceed and investigate the effects of the policy on other outcomes. Descriptive statistics from both surveys provide this kind of indication but we need to address this issue properly by especially looking whether wage effects of the minimum wage were higher in homes that seemed to be affected the most by the policy.

4.5 The Effects of the UK National Minimum Wage on Wages and Employment

4.5.1 Wage Effects

In the previous sections as well as in Machin, Manning and Rahman (2003) it is suggested that the wage effects of the introduction and increase in the NMW should be looked first of all, as a significant NMW effect on wages is a prerequisite in order to look for further effects on employment and other outcomes.

In tables 4.4 and 4.5 are presented measures of the 'bite' of the minimum wage 1999 introduction and 2001 increase respectively. Both tables indicate that a large proportion of workers were affected by both the introduction and the increase in the minimum wage and also that these minimum wage changes generated a sizeable increase in the wage bill, as suggested by the wage gap variable.

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analysis.

Additionally, both tables indicate that the adult rate is binding for most care homes in 1999 and 2001, as around 30% of all workers in the full and balanced sample of homes are paid below the adult rate before the 1999 NMW introduction, whereas around 30% and 26% of all workers in the full and balanced sample respectively are paid below the adult rate before the 2001 NMW increase. Moreover, the wage gap measure of the impact of the minimum wage suggests a sizeable impact as tables 4.4 and 4.5 indicate a 2.4% and 2% increase in the weekly wage bill for the full and balanced sample respectively for the 1999 introduction as well as a 1.5% and 1.3% increase for the full and balanced sample of homes respectively for 2001.

Therefore, in contrast to the changes in the average hourly wage between the pre and post introduction and increase surveys discussed in the previous section, the measures of the 'bite' of the NMW suggest a stronger impact of the minimum wage on the wage structure for the 1999 introduction compared to the 2001 increase, something not surprising if one accounts that in 1999 the NMW was introduced in a previously unregulated labour market.[176]

[176] Note that 'bite' statistics presented in table 4 and 5 are different (especially for the proportion of affected workers) than those presented by MW (2004). The difference can be mainly explained by two points: The one is that difference in the way the two measures of the impact of the NMW were calculated. As suggested by MMR (1999), the data were punched in the computer by various students, and that is why we had a closer look for any errors in the variables of interest. In particular, MMR and MW use two different measures for the impact of the minimum wage: the proportion of workers whose wage is affected by the minimum wage (covered workers that are paid an hourly wage that is below the age specific minimum rate before the NMW introduction and increase) and the wage gap (the proportional increase in the weekly wage bill at home if the wages of workers affected is increased to meet the age specific minimum wage). We calculate the proportion of affected by the minimum wage workers as the ratio of the number of workers with information on whether they are covered and affected (i.e. whether they are paid below their age-specific minimum rate) to all workers with information on whether they are affected or not by the NMW. The same approach is used in the calculation of the sample values of the wage gap variable. A comparison of the minimum wage impact variables calculated as described above with those calculated by MW (which were included in the data sent to us by the authors), seems to suggest that the former take into account more information and that is why their values are noticeably different than the latter (for example we account those that are not covered, i.e. those below 18 years old and those paid above the adult rate as not affected even in the case where there

The summary statistics presented in figure 4.4 and 4.5 also suggest a noticeable spike of the wage distribution on the adult rate as around 24% of all workers in both the full and balanced sample for the 1999 and around 20% and 18% of all workers in the full and balanced sample respectively for 2001 are paid the adult rate after the NMW introduction/increase. The spike of the wage distribution on the minimum wage is one of the main stylized facts of the minimum wage literature (Brown 1999).[177]

The "bite statistics" combined with the spike at the adult rate of the post-1999 and 2001 youth hourly wage distributions presented in figures 4.11 and 4.12 seem to support a low utilisation of youth subminimum wages, another well-documented fact of the minimum wage literature.[178]

The spike of the wage distribution at the adult rate is clearly observed in figures 4.14 and 4.16 (see figures section at the end) of the hourly wage distribution for all workers in the post 1999 NMW introduction and post 2001 NMW period respectively. More comparisons the hourly wage distribution before and after the 1999 NMW introduction (figure 4.13 and 4.14) and 2001 NMW increase (figure 4.15 and 4.16) suggests clear compres-

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is not information on their hourly wage and age respectively). Moreover, the difference between our "bite statistics" and that presented in MW could be also attributed to the differences in the size of the sample of all care homes from the south coast of England. In particular, MW report statistics based on a sample of 530 and 581 carehomes in the whole sample in the pre and post 1999 survey respectively, whereas our figures are derived from a sample of 548 and 579 homes respectively. Moreover, for 2001 MW report a pre and post NMW increase sample of 482 and 404 respectively whereas our analysis was based on 411 and 333 homes respectively. Moreover, our analysis of the balanced sample of homes is based on 195 homes in 1999 and 152 homes in 2001 respectively, whereas MW report statistics and estimates from a sample of 181 and 173 homes for 1999 and 2001 respectively.

[177] Once more and for the reasons explained above, the our measures of the spike at the adult rate slightly differ from those presented by MW 2004).

[178] Note that out of 827 employees from the full sample and of 275 from the balanced sample that are covered by the development rate only 41 and 14 employees respectively are paid exactly the youth rate after the 1999 NMW introduction. Similarly 11 out of 390 employees in the full sample and 1 out of 178 covered by the development rate are paid this rate after the 2001 NMW increase.

sion of the distribution of hourly wages which is also consistent with findings presented by Dickens and Manning (2004), supporting the argument that minimum wages decreased wage inequality in the care home sector.

Following the above discussion, the next question to be addressed is whether the highest wage changes occurred at homes that were affected the most by the minimum wage.

The basic empirical specification used throughout is

$$\Delta O_{ht} = \alpha_0 + \alpha_1 MIN_{h,t-1} + \alpha_2 X_{h,t-1} + \varepsilon_{ht} \text{ (1)}$$

where ΔO_{ht} measures the change in the outcome of interest, O, for home h in period t before and after the minimum wage introduction/increase. $MIN_{h,t-1}$ is the pre-minimum wage variable, X is a set of pre-minimum wage home characteristics and ε_{ht} is a random error.

As long as the minimum wage randomly assigns the population of care homes into more and less affected the parameter $\alpha_1$is a true measure of the effect of the minimum wage on the outcome of interest. The main concern about the validity of the latter identification assumption is that, given that the NMW is set at the same level nationally, variation in the minimum wage impact measures comes from variation in initial wages. MMR test this identifying condition by looking whether there is any (or a different) relationship between initial wages or minimum wage impact measures and the change in the outcome of interest (in particular the change in wages and the change in employment) in a period where no NMW was introduced.[179] The main findings indicate that there is no or little relationship

179 The counterfactual was the South Coast care home sample surveyed the responded in the two surveys for

between initial starting wages and the minimum wage impact measures and the change in the wages and employment, and that these relationships have significantly shifted at the time of the 1999 NMW introduction.[180]

In table 4.6 we present estimation results from wage specifications with dependent variable the change in the log average hourly and change in the log weekly wage respectively. We find a positive and significant effect of both the 1999 introduction and 2001 increase in the minimum wage on the change in average hourly wage, that persists throughout all specifications and measures of the minimum wage impact.

A striking finding is that our estimates suggest that the 2001 NMW increase had a significantly larger impact on care homes average hourly wages compared to the 1999 NMW introduction.[181] This finding may not seem surprising if we consider the changes in the average hourly and weekly wages before and after the 1999 introduction and 2001 increase discussed in the previous section but it may seem if one considers the measures of the 'bite' of the NMW for the period of the introduction and the increase which suggest that the NMW was more binding in 1999 compared to 2001. However, the descriptive analysis of the 'bite' of the NMW does not necessarily contradict the regression analysis of wages as the two are complements for each other.

data collection in the window of the 92/92 UK elections.

[180] This finding limits any concerns of endogenous variation in the minimum wage impact measures due to variation in initial wages across homes. The introduction of controls for home and employers characteristics further limits any variation in the minimum wage impact measures that is generated from variation in initial wages.

[181] For the 98/99 balanced sample our estimates are slightly different than MW, which could be explained by the difference in the measures of the minimum wage impact and the sample size discussed above as well as the fact that we use imputed information for missing values of the controls included in regressions as well as missing value dummies so that to avoid reductions in the sample.

In particular, the interpretation of estimates of specification (1) from both the 98/99 and 01/02 samples suggests that a home that has 1% higher proportion of affected employees experienced on average a 0.12% higher growth on hourly wages after the 1999 NMW introduction compared to a 0.26 % higher hourly wage growth after the 2001 NMW increase. The same is the case if one compares estimates from specifications that include the wage gap as the minimum wage impact measure. Particularly estimates from specifications (3) of both samples indicate that a home with a 1% higher increase in its weekly wage bill after the 1999 NMW introduction will experience on average 1.2% higher hourly wage growth compared to 3.7% hourly wage growth after the 2001 NMW increase.

The latter result seems to be against conventional wisdom as one wouldn't expect that the NMW increase would have had greater impact on wages compared to the NMW introduction to a previously unregulated labour market. Moreover, this result is also different than the findings of MW, who although they also find positive and significant wage effects of the NMW introduction and increase throughout specifications and minimum wage measures, they report higher wage estimates for the 1999 NMW introduction compared to the 2001 NMW increase from the sample of care homes from the south coast of England.

A potential explanation of this finding (except of the differences between our analysis and that conducted by MW in terms of sample sizes and minimum wage measures) may be that although at the period of the introduction the NMW floor was set in a previously unregulated labour market, its level is quite prudent as also suggested by the Low Pay Commission reports (LPC) (June 1998, February 2000), probably because of the initial fear of employment losses. Moreover, the 2001 increase is the most generous to date, because the levels were set after detailed research and consultation as well as after taking into account previous experience of the NMW increases that may have limited concerns of employment losses.

Furthermore, as presented by table 4.6 we find that the effect of minimum wage on the growth of average weekly wage is positive but insignificant throughout all specifications and minimum wage measures for the 98/99 sample and positive but usually in the fringe of statistical significance for the 01/02 sample.

Once more we find that the NMW 2001 increase had a more sizeable impact on the change in the log weekly wage across homes. Moreover, our findings in this case differ from those of MMR(2003) who found that the NMW not only had a significant effect on both hourly and weekly wages but also that the effects were very similar in magnitude across care homes from all areas of the UK.[182]

An explanation of our findings of a weaker minimum wage effect on weekly compared to hourly wages could be that although the hourly wage may have increased as a result of the minimum wage, number of hours may have changed as well but in the opposite direction (this hypothesis is investigated in a following section) leading to lower weekly wage increases than those expected if hours were not affected by the policy.

In conclusion in this section we present evidence of significant positive effects of minimum wage on wages, and thus we can now look for effects of minimum wages on other outcomes starting from the employment effects, the most heavily researched hypothesis in the minimum wage literature.

[182] In our case, even when the NMW effects on weekly wages are significant (as it is the case for the 01/02) their magnitude is lower than the NMW effects on hourly wages.

4.5.2 Employment Effects

In this section we look at the effects of the NMW on employment. In particular, we investigate the effects of the 1999 NMW introduction and increase on both the number of employees and on total hours in the care homes sector.[183]

Results on the change in log number of employees and change in log total weekly hours for both the 98/99 and 01/02 periods are presented in table 4.7.

First of all we find that the NMW effects on the change in the number of employees are negative and significant for the period of the 99 introduction only when the proportion of low-paid is used as the measure of the impact of the minimum wage, whereas it is negative but insignificant when the wage gap is used as the minimum wage measure.[184] In particular, our estimate from specification (1) in the upper panel of table 4.7 which reports estimates for the effect of the 1999 NMW introduction, suggests that a home with 10% higher proportion of affected workers before the NMW 1999 introduction will experience on average a 2.8% lower growth in the number of employees.

As far as the effects of the 2001 NMW increase in the change in the log number of employees is concerned our estimates reported in table 4.7 indicate that employment effects are insignificant throughout all specifications and all measures of the minimum wage impact used. Interestingly, the estimated employment effects are positive in most

[183] MW report estimates of the effects of both the NMW introduction and increase for only one employment measure. It is not clear whether this measure is the number of employees or total hours but considering the similarity of their estimates for the 98/99 from the sample of care homes from all UK areas used also by MMR, with MMRs estimates using the number employed as the the employment measure, we infer that MW results involve the number of employees. The investigation of the effects on both bodies and hours is important as employment adjustments may involve both bodies and hours.

[184] As suggested by MMR (2003) and MW (2004) both measures were used in regressions, as we cannot be sure which one is the best measure to pick up the effect of the minimum wage.

of the cases.[185] Again as in the case of wage effects our results are different that those produced by MW as they find negative and most of the times insignificant employment effects of the 2001 NMW increase. Furthermore, MW's estimates from the 98/99 sample of homes from south coast suggests that their estimates are negative and significant but slightly different than those presented in table 4.7. Once more, differences in the estimated results could be attributed in differences in the sample size, the minimum wages measures and the use of imputed information for missing values and missing value dummies for the controls included in regressions.

Furthermore, when the change in log total weekly hours is used as the employment measure in regressions we find a negative but either insignificant or marginally significant effect of the NMW 1999 introduction on employment.[186] Once again we find a positive and insignificant effect of the 2001 NMW increase in total weekly hours to be the case in all specifications and under both measures of the impact of the minimum wage.[187]

The fact that we find some negative effects of the 1999 NMW introduction on the change in weekly hours is consistent with the above result of a weaker positive effect of the NMW introduction on weekly wages. Moreover, in the case of the 2001 NMW increase we do not find any significant effects on total weekly hours under all specifications and

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185 However, note that the NMW effect on the number employed is negative and insignificant when one accounts only for the employment of care assistants.

186 Estimates are more strongly significant when the dependent variable is the change in total hours of care assistants.

187 However, we find some negative and sometimes on the fringe of statistical significance estimates when the dependent variable is the change in log total weekly hours of carcassistants. Because the hours of care assistants fell slightly as a result of the 2001 NMW increase one could expect that total hours at home should also have fallen, if the hours of the rest of workers were unaffected. We found that the NMW had a positive but insignificant effect on the hours of non care assistants, and thus the positive and insignificant effect of the 2001 increase on total hours of all employees may be probably explained by the fact that hours of care assistants, as suggested by the overall results fell slightly.

minimum wage measures used, a finding which further explains why the minimum wage increase had a positive and significant effect on weekly wages, considering also the positive and significant effect it had on hourly wages.[188]

All in all the evidence suggests that although the minimum wage generated a significant boost in the wages of care home workers, there are some employment losses only in the period of its introduction, a finding that is consistent with both previous studies conducted by MMR and MW. On the other hand we fail to find any significant (negative) employment effects of the 2001 NMW increase, a finding that seems quite surprising considering also the more sizeable impact that the 2001 NMW increase had on wages in care homes.

This latter finding is surprising, as provided the evidence that the 2001 NMW increase generated on average a more significant boost in hourly and weekly wages than the 1999 NMW introduction, we would expect more significant disemployment effects of the 2001 NMW increase compared to the 1999 NMW introduction. However, a better explanation of the observed employment effects of the NMW introduction and increase could be provided once we also get some evidence of the effects on other outcomes as at the same time other adjustments may have taken place.

The negative minimum wage employment effects of 1999 seem to be quite moderate, considering the impact that the minimum wage had on the wage sector of the care homes sector. An explanation of the moderate or no employment effect of the NMW in-

[188] The fact that we found some evidence (not presented in the regressions of table 7) that the hours for care assistants fell slightly whereas the number of all employees and the number of all employees and the number of careassistants in particular didn't change significantly after the NMW 2001 increase may explain why the NMW effects on hourly wages are larger in magnitude and more significant than that of weekly wages.

troduction and increase, could be provided by the claim of the low pay commission (Low Pay Commission 1998) that "a detailed investigation-consultation across the country takes place before any wage increase so that the rates will be calculated and set at a prudent level that will make sure that there is a boost in low-wage workers incomes that doesn't destroy their jobs".

In general, our findings are in line with MMR and MW that suggest that a minimum wage introduction and increase boosts low-paid workers earnings and cause little or no harm in their employment

4.6 The Effects of the UK National Minimum Wage on Other Outcomes

In the following sections we present our findings on the effects on the NMW 2001 increase on other outcomes such as prices, labour productivity and effort as well as the effects of both the 1999 NMW introduction and increase on profits and long-run outcomes as the skill composition of workforce and capital/labour relative utilisation.[189] Moreover, we also look at any NMW effects on supervision intensity and other offsets that are predicted by efficiency wages as changes in employees' quality, tenure and turnover.

Our main objectives are: to extend MW's analysis that focused on wages, employment and closures and in this way to look for other possible adjustments that may have

[189] The effects of the 1999 NMW introduction on prices, labour productivity and effort have been investigated by MMR (2003). MW investigated the effect of the NMW 1999 on home closures, as discussed in section 3. When we reproduced the same investigation using the data from the south coast subsample of care homes for 1999 we find very similar results as MMR and MW and thus we exclude the presentation of these results from our analysis. In the following sections we present our findings if they have not been investigated by existing studies or if they have been investigated by existing studies, but they are significantly different.

been the result of minimum wage increases; to investigate the effects of the minimum wage policy in the long run and thus provide a credible attempt to fill an important gap of the literature; and finally to test one the main premise of our thesis that efficiency wages considerations may be particularly relevant in low wage labour markets by looking into some of the implications of the theoretical model we developed in chapter 2, as well as the implications of other seminal efficiency wages models (Salop 1979, Weiss 1980, 1990).

4.6.1 Prices

The effects of the minimum wage on product prices of low wage firms consist another important gap of the minimum wage literature (Card and Krueger 1995, Brown 1999). MMR investigated the effects of the 1999 NMW introduction on average weekly price of bed in their sample of care homes across the UK and find no evidence of price effects. This finding was explained by the fact that there is a significant proportion of care homes residents for whom the price of services is regulated by local authorities and thus cannot be freely adjusted by the owners of care homes. This is actually one of the characteristics that rendered the care homes sector an ideal one to study the effects of the NMW, as discussed by MMR and MW. In fact, further information provided by local authorities indicates that local authorities/social security funding didn't increase after the 1999 NMW introduction and that is why care homes couldn't pass on the increased wage costs generated by the NMW introduction to prices (see MMR 2002).

However, MW present no evidence of price effects of the 2001 NMW increase on care homes from the south coast of England. This evidence is important as they could cast further light on the overall impact of the 2001 NMW increase in the care homes sector and could also provide a better picture of any possible offsets generated by minimum wage increases.

Estimates of minimum wage effects on the change in log average weekly price of bed of south coast care homes are presented in table 4.8. Estimates of the price effects of the NMW 2001 increase are not in line with those from the 1999 introduction. In particular, we find that prices grew faster in homes that were most affected by the minimum wage 2001 increase. For example as suggested by the estimated results summarised in the right panel of table 4.8 the average weekly price of bed growth was on average higher by 2.2% in a home that had 10% more affected employees or at a home that experienced a 1% higher increase in the weekly wage bill as a result of the minimum wage compared to other homes.

Information from local councils suggests that although prices of care services provided by care homes are regulated by local authorities, in contrast to the period before and after the 1999 introduction, there wasn't any price capping in the period before and after the 2001 NMW increase.[190]

Therefore, based on evidence on price effects of the NMW 2001 increase we may infer that although prices were capped for the period around the 1999 NMW introduction, the same wasn't probably the case for the 2001 NMW and thus the NMW increase generated substantial increases in the average price of services of residential care homes.

[190] This information is further supported by the fact that we fail to find a significant effect of the proportion of dss residents on price growth. The same is the case for an interaction variables of minimum wage impact measures and the proportion of residents at home whose fees are not paid by local authorities. These results suggests that we find no evidence that price increases in 2001 were the result of increases only in the price of services for residents for whom fees are not covered by local authorities, because of local authority funding capping that restricted care homes managers/owners to pass on wage costs to residents with fees covered by local authorities.

4.6.2 Profits

Most theoretical models developed to analyse the effects of the minimum wage policy in low-wage labour markets or low-wage industries generate predictions on the effects of minimum wages on profits. However, few empirical studies investigate the effects of minimum wages on profits (Card and Krueger 1995, Brown 1999). Furthermore, the two previous care homes studies produced by MMR and MW do not address this issue.

In this section we are investigating the effects of the NMW 1999 introduction and 2001 increase on trading surplus, which is our proxy for profits.[191] As suggested by results reported in table 4.9, we find no significant changes in the trading surplus rate of care homes between the period of pre minimum and post minimum wage introduction and increase, a result which again persists across specifications and minimum wage measures used.

The main difference between the estimated effects of the minimum wage introduction and increase on the trading surplus of care homes was that estimates from the 98/99 sample are positive and insignificant, whereas those from 01/02 sample are negative and insignificant. However, estimates from 98/99 should be more reliable, compared to those from 01/02 because in the latter case there wasn't sufficient information in order to use an unbiased measure of trading surplus.

In general, as far as the 1999 NMW introduction is concerned we find that there is a substantial increase in wage costs across homes followed by some small reduction in employment (in hours and bodies) and no change in the price of service, findings which

[191] See notes of table 9 for details of how trading surplus was calculated.

may suggest that we should expect that significant effect of the NMW 1999 introduction on profits should have been observed.

Nevertheless, in order to provide a better explanation on the effects on profits it is better to look also for other possible adjustments in care homes that may have taken place, as substitution of production inputs and changes in effort or productivity across homes.

4.6.3 Long Run Effects

As suggested above more evidence on the long-run effects of minimum wages is needed. As far as the NMW effects in the care homes sector MMR and MW investigated the relationship between homes exit and entry and the NMW introduction but failed to find any systematic relationship between the minimum wage and homes closures or openings.

In this section we are looking for evidence on long-run adjustments as a response to the NMW, such as substitution of capital and higher skilled for lower skilled labour. These issues haven't been investigated by the main previous studies of the effects of the NMW.

Theoretical models often used to predict the impact of the minimum wage on labour market outcomes suggest that in the long-run a minimum wage increase may cause substitution of capital (or higher skilled labour) for lower skilled affected labour or vice versa. In order to test these predictions we estimate specifications where the dependent variable is the log number of beds to number of employees and log number of beds to number of total weekly hours of work at home ratio,[192] and the ratio of skilled (proportion of employees

[192] The main justification of the use of the number of beds is that this is the only capital information included in the 98/99 and 01/02 care homes data.

with nursing qualification) to unskilled employees (those with no qualification, as nursing qualification is the only relevant qualification in the industry).

As indicated in the upper panel of table 4.10 we find a positive and significant effect of the NMW 1999 introduction on the number of beds per employee and on the number of beds per weekly hour of work which are our proxies for the capital/labour ratio, only for specifications that include the proportion of affected workers as the minimum wage measure. Moreover, as suggested by the upper and lower panel of table 4.10 we find no effect of the 2001 NMW increase in the change in the number of beds per employee or per weekly hour of work.

Given our results on the effects of the NMW 1999 introduction and 2001 increase on the employment in bodies and in hours presented in table 4.7, it is very likely that the results of the effects of the NMW on the ratio of beds per employee or per weekly hour are driven by the changes on the two measures of employment generated by the changes in the NMW. This explanation is supported further by estimation results of the effect of the impact of the NMW introduction and increase on the log number of beds presented in the lower panel of table 4.12.

As indicated in the lower panel of table 4.12, we do not find evidence of any minimum wage effect on the change in the number of beds in care homes for both the 98/99 and 01/02 periods. Therefore, the evidence suggests that overall there was no change in the capital/labour ratio as measured by the number of beds per employee or per weekly hour of work that can be attributed to substitution of capital for labour for both the period of the NMW introduction and increase.

Furthermore, table 4.11 presents estimation results for the effects of the NMW on the ratio of employees with nursing qualification to employees with no nursing qualification, which is a proxy of the ratio of high to low skilled labour at home. Again we fail to find any evidence of changes in the relative utilisation of skilled labour, as suggested by the estimates presented in table 4.11.[193]

All in all, the evidence in this section suggests that home owners/managers didn't increase the number of beds relative to employment measured in bodies or in hours in order to offset some of the costs generated by the minimum wage.

Finally, we find no evidence of any minimum wage effect on the change in the skill-composition of workforce in care homes in the 98/99 and in the 01/02 sample. Again a potential explanation of the lack of any evidence that suggests substitution between factors of production may be that the post-introduction and post- increase surveys conducted relative close to the time of the intervention and thus it is not likely that long-run adjustments as that of substitution between factors of production may have occurred.

[193] We also looked for any changes in the employment of employees with nursing qualification relative to those with no qualification in terms of hours. We find an increase in the hours of qualified employees only for the 98/99 sample and only in the same specifications for which a significant employment effect in terms of hours of all workers or all care assistants was produced. This suggests that any evidence of relative increase in the hours of work of more qualified employees is not due to substitution of of these workers for workers with no nursing qualification but mainly because of the reduction in the hours of work of low-skilled workers. However, results from regressions of the change in the total hours of employees with nursing qualification to those with no qualification are likely not to be so robust as infromation was quite patchy.

4.6.4 Output, Workers Productivity and Effort

In the upper panel of table 4.12 are presented estimation results from specifications with dependent variable the change in the natural logarithm of the number of residents (a measure of care homes output) at home in 98/99 and 01/02 periods.

Results suggest that the change in the NMW had no effect on output as measured by the number of residents at home, except of the case of the 1999 NMW introduction and only when the proportion of affected workers at home is the measure of the impact of the minimum wage, where we find that output fell as a result of the introduction. The pattern of the NMW output effects resembles closely that of the NMW employment effects as measured by the number of employees and total weekly hours of work.[194]

Table 4.13 summarises the results from the estimation of various specifications with dependent variable the change in employees productivity as measured by the number of residents in home per employee and the number of residents per weekly hour of work and employer's perception of changes in effort as a result of the NMW 2001 increase.[195]

Estimates presented in the upper and middle panels of table 4.13 suggest that the 2001 NMW increase had no significant effect on either the change in the log number of residents per employee or the change in log number of residents per weekly hour of work in care homes. This finding is consistent with the results of MMR that find no effects of the

[194] Taking into account both the results on the NMW effects on the number of residents and the number of beds presented in table 13, we can infer that the NMW introduction and increase had no signifcant effect on the occupancy rate in the care home sector.

[195] The data collected before and after the 2001 NMW increase do not include information on the number of residents but only the number of residents whose costs are paid by local authorities and the department of social security. Information on the change in effort is based on homes managers/owners subjective answers to questions on whether or not work effort changed as a result of the NMW introduction and increase and if effort has changed, whether it decreased or increased (see MMR 2002 for the questions included in the questionnaire used for the data collection).

NMW 1999 introduction on the number of residents per weekly hour of work. This can be also inferred by the similar patterns in the number of employees and weekly hours and the number of residents for 1999 presented in tables 4.7 and 4.12 respectively.

In general evidence of wage effects on employees' productivity is of essence for the validity of efficiency wages. However, in this case the fact that we find no evidence of any NMW effects on labour productivity across care homes should be interpreted with caution as this evidence can be mostly viewed as minimum wage effects on the relative change of output and employment rather than as minimum wage effects on the change of employees' productive behaviour which is a necessary condition for the validity of efficiency wages.

Therefore, this evidence does not particularly mean that because output per worker hasn't changed implies that employees' productive behaviour (for example the intensity by which employees work) hasn't also changed, as it may be the case that when employment fell, the fall was such that more than offset an increase in employees effort and in this way may have led to output reductions per employee or per hour of work.

We now turn to the effects of the NMW on effort across care homes. The lower panel of table 4.13 presents ordered probit estimates of the effects of the NMW introduction and increase on subjective responses of homes owners/managers about changes in work effort.[196] Results suggest that the NMW had no impact on the probability that effort will be increased relative to that of being decreased for the 04.1/02 balanced sample of care homes. MMR found similar results for the NMW 4.1999 introduction.

[196] The effort specification we used in the ordered probit estimation is the empirical counterpart of the non-shirking condition for continuous effort derived in our theoretical model of chapter 2. Note that according to the theoretical specification of NSC supervision intensity should be also included as one of the explanatory variables in the effort empirical specification. However, as we also show below, supervision intensity is endogenous and is correlated with the minimum wage measures and that is why we exclude it here.

Again this evidence shouldn't be interpreted as being against of the validity of efficiency wages as first of all the information on effort is subjective and second there may be other realised gains arising from the NMW introduction and increase. We looked into this question in the next section.

In summary, the investigation of the effects of the NMW introduction and increase on output, labour productivity and subjective effort in care homes produces some evidence of a fall in output after the 4.1999 NMW introduction and no evidence of effects of the 2004.1 NMW increase on output, labour productivity and effort. However, as discussed above this evidence does not imply anything about any effects the minimum wage may have had on employees productive behaviour in particular, and that is why in the next section we are investigating this issue by looking whether the NMW generated other gains in terms of reduction in costs associated with personnel practices in homes such as supervision or in terms of employees' quality.

4.6.5 Supervision

The main objective of this paper is to test empirically the validity of the hypothesis that efficiency wages considerations may be particularly valid in low wage labour markets, by testing the prediction of the shirking models of efficiency wages of a wage-supervision trade-off.

In this analysis the design of both surveys enables us to address probably the most important problem that hinders the identification of the relationship between wages and supervision, namely the endogeneity bias. Moreover, the choice of the care homes sector which is non unionised, with relatively homogeneous occupations and skills but also homogeneous services (MMR 2003), significantly abates other concerns and problems generated by unobserved heterogeneity.

Additionally, the fact that we have observations on the variables of interest at two different points in time allows us also to control for time invariant unobserved factors that are correlated with supervision intensity and wages, including also measurement error that is another problem that makes the identification of the relationship between wages and supervision particularly vexing.[197]

Supervision intensity and wages are both choices of the firm and in a regression of wages on supervision it is expected that unobserved factors that affect wages will be also correlated with supervision intensity.[198] Another important issue is concerned with the direction of the endogeneity bias. The sign of the bias depends on the relationship of omitted variables with wages and supervision. Moreover, the identification of the main confounding factors and the nature of their relationship with wages and supervision is usually specified by the rational or theory underlying the determination of wages and supervision.

For example under the rationale provided by efficiency wages models, effort is increasing in the wage and supervision and thus in equilibrium, provided that everything else is constant there is a trade-off between wages and supervision. If the relationship between wages and supervision is as predicted by efficiency wages, then we would expect that the

[197] The empirical literature of the wage-supervision relationship suggests that the problem of measurement is particularly related to supervision intensity, as the measure of most often in the literature is the ratio of supervisors to staff that may overestimate the extent of monitoring as supervisors may not all the time monitor employees but just simply coordinate and guide them on the job (Rebitzer 1995). Moreover, the supervisor to staff ratio does not pick up any differences in the quality of monitoring across care homes (Brunello 1995).

[198] The same holds if one regresses supervision on wages as the determination of both wages and supervision by the employer can be modeled using a simultaneous equations model.

omission of factors that affect effort intensity across establishments will cause a positive bias because firms that require their workers to work harder will set supervision and wages at a higher level. Similarly, again under the efficiency wages assumption that wages and supervision are effort regulating devices, we expect that firms which have better employment practices or use other motivation devices as well will pay lower wages and supervise workers less stringently, to achieve a given effort target (Rebitzer 4.1995).

Another factor that may also cause an upward bias in the relationship of interest is unobserved differences in effort technology across firms, for example because of the systems that govern labour-management relations that may make effort more responsive in wage and supervision in some firms (Gordon 4.1990, 4.1994).

On the other hand other theories of the wage-supervision determination specify different omitted factors of interest and predict a negative bias. This is the case if it is true that better quality workers, which are paid higher wages, are supervised less stringently because they need less guidance and coordination on the job. According to this "sorting by ability" model (Groshen and Krueger 4.1990), unobserved workers' quality will cause a negative bias in the relationship of interest.

Another explanation of a wage-supervision trade-off which again makes an assumption about workers' (not union's) preferences on supervision can be provided by the "equalizing differences" theory that predicts that if workers like supervision, because for example supervision helps them to achieve career goals (Groshen and Krueger 4.1990), then they will be willing to receive lower wages if they will be supervised tighter (i.e. they will receive a negative wage-differential as supervision is regarded as a good working condition).

Our analysis in this section uses a different identification strategy than the previous sections, as we use the minimum wage as an instrument to obtain IV-2SLS estimates of the structural parameter of the change in wages on the change in supervision intensity and in this way to test the prediction of the shirking model that in equilibrium there is a trade-off between wages and supervision.

In particular, a simple structural model of the change in supervision is derived from Georgiadis (2004.1) that extends the standard Shapiro-Stiglitz (4.1984) shirking model to allow for endogenously determined supervision intensity. The structural model is given by equation (2):

$$\Delta S_{it} = \beta_0 + \beta_{4.1}\Delta \ln W_{it} + \beta_2\Psi_{i,t-4.1} + u_{it} \quad (2)$$

where ΔS_{it} is the change in supervision intensity, ΔW_{it} is the change in the natural logarithm of the hourly wage at home and measured as the ratio of managerial to non-managerial employees between the pre and post NMW introduction/increase period, $\Psi_{i,t-4.1}$ is a vector of firms and workers' characteristics that also determine the intensity of supervision[199] and u_{it} is a random error. In order to derive the reduced form of model (2),we substitute the following reduced form equation that expresses the change in the wage as a linear function of the instrument $MIN_{i,t-4.1}$and the control variables of model (2). The latter reduced form model is given by equation (3):

$$\Delta \ln W_{it} = \gamma_0 + \gamma_{4.1}MIN_{i,t-4.1} + \gamma_2\Psi_{i,t-4.1} + v_{it} \quad (3)$$

[199] These characteristics aim to pick up heterogeneity in the quit rate, the probability of finding a job once a worker is dismissed and the time preference rate across homes, which are determinants of the intensity of supervision according to the theoretical model

where $MIN_{i,t-4.1}$ is a measure of the impact of the minimum wage in the pre-NMW introduction/increase period (either the proportion of workers affected or the wage gap) and v_{it} is an error term. Substituting $\Delta \ln W_{it}$ from (3) into (2) we derive the estimable reduced form supervision change equation of the form:

$$\Delta S_{it} = \delta_0 + \delta_{4.1} MIN_{i,t-4.1} + \delta_2 \Psi_{i,t-4.1} + \xi_{it} \ (4)$$

where ξ_{it} is a random error.

Therefore we are able to estimate parameter $\beta_{4.1}$ by using $MIN_{i,t-4.1}$ as an instrument for $\Delta \ln W_{it}$ in model (2). In this particular case (when there is only one instrument) it could be shown that $\beta_{4.1} = \frac{\delta_{4.1}}{\gamma_{4.1}}$, and thus an estimate of $\beta_{4.1}$ can be derived by estimating models (3) and (4) and calculate the ratio of the OLS estimates of $\delta_{4.1}$ and $\gamma_{4.1}$.[200]

Firstly, we are interested in investigating the direction of the endogeneity bias. This is why we compare estimation results from OLS regressions of the change in supervision intensity on the change in log average wage across homes surveyed before and after the 4.1999 NMW introduction and 2004.1 NMW increase, with two-stage least squares (2SLS) estimates of the relationship between supervision and wages.

In table 4.14 we present comparisons of two-stage least squares (2SLS) estimation results with OLS estimates using the same specifications for the 98/99 and 04.1/02 samples

200 The main identifying assumptions of the IV is that the instrument is correlated with the endogenous variable of interest and uncorrelated with the error term. Results from the estimation of wage change equations in one of the previous sections indicate a strong correlation of minimum wage impact measures and the change in the wage and thus seem to support that the minimum wage is a strong instrument for the change in the wage. Moreover, MMR's test discussed previously seems also to support the fact that variation in the minimum wage measures is exogenous which further supports the instrument exogeneity condition. Finally, we expect that there is no concern that the instrument would affect the change in supervision through another channel than that of the change in hourly wages, as the minimum wage is a pure exogenous wage increase.

when the instrument for the change in the average wage is the proportion of affected workers (upper panel) and the wage gap (lower panel) respectively. In both the upper and the lower panels OLS estimates of the effect of change in the wage on the change in supervision intensity are in their vast majority positive and significant. This result is consistent with the prediction of our theoretical model that the relationship between wages and supervision is positive, when everything else is not constant.[201]

As indicated in table 4.14, two–stage least squares estimates are systematically smaller (not in absolute value) than the corresponding OLS estimates and in some specifications are turning to negative and significant. The former result supports the prediction of a positive endogeneity bias. The wage-supervision trade-off is significant for the 98/99 sample when the proportion of affected workers is used as an instrument for the change in average wage[202] and marginally significant when the wage gap is the selected instrument[203] and when also controls for employees and home characteristics, including controls for turnover, effort and monitoring costs.

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201 In particular the prediction of our theoretical model (Geogiadis 2001) suggests that the wage-supervision relationship is expected to be positive when effort or/and employees' quality are not held constant. In other words, this latter prediction indicates the expected sign of the endogeneity bias of OLS estimates of the wage-supervision relationship, when one fails to control for effort or/and employees' quality differences across firms. Another effort related positive bias may be produced by differences in effort technology across homes, because in homes that effort is more responsive in effort and supervision are expected to set both higher wages and supervision levels. However, in general the use of first differences of the supervisor to staff ratio may abate the OLS bias.

202 A two-tailed test of the null hypothesis of no systematic relationship between the change in supervision intensity and the change in average wage is rejected at 4.7% level of significance, whereas a one-tail test of the null where the alternative is that the relationship of interest is negative rejects the null at 2.35% level of significance.

203 A one-tail test rejects the null at around 8% level of significance.

Furthermore, for the 04.1/02 sample although we do find evidence of a negative OLS bias we fail to find any negative and significant estimates of the relationship of the change in supervision intensity and the change in average hourly wage across homes.[204]

As long as the 2SLS is a consistent estimator of the true relationship between wages and supervision, we find evidence of a wage-supervision trade-off for the 98/99 sample, presented in table 4.14. A negative relationship between wages and supervision is consistent with three theories/rationales: a) efficiency wages, b) the 'sorting by ability' model and c) "equalizing differences" under the assumption that supervision is a 'good' working condition.[205]

If the 'sorting by ability' model consists the main explanation of our results then we would expect that the OLS bias caused by unobserved differences in workers' quality across homes, would be negative,[206] which is not the case here. Furthermore, unless unobserved quality is uncorrelated with observed, we find no evidence that unobserved workers' quality across homes causes a negative bias in the estimate of interest, as suggested by the estimation results summarised in table 4.14, where the inclusion of controls for workforce quality characteristics (proportion female, proportion with nursing qualification, etc.) indicates that there is any unobserved quality bias is positive rather than negative.[207] Therefore,

[204] It may be the case that the lack of significant results for the 01/02 sample is due to the fact that less information is available compared to the 98/99 sample and thus less relevant controls are included in the regressions of the change in supervision.

[205] The wage-supervision trade-off can also be explained by differences in union bargaining power, under union-firm bargaining over wages and supervision when unions bargain over working conditions and effort and when unions "like" wages but "dislike" supervision. However, in this case this theory does not apply as the care homes sector is non-unionised.

[206] This holds either because the 'sorting by ability' is the only underlying theory of the wage-supervision relationship or because, even in the case the other theories are involved that lead to positive biases, the sorting by ability is the dominating explanation and thus the negative bias dominates.

[207] If the fact that the dependent variable includes dirst differences implies no concern for unobserved work-

based on the latter arguments, one could probably dismiss the 'sorting by ability' interpretation of the negative wage-supervision relationship.

Finally, if "equalizing differences" consist the only or dominating explanation of our findings, then we would expect that the direction of the OLS bias will be negative and not positive, as if workers 'like' supervision then we would expect that lower wages are paid in homes with higher supervision intensity.[208] However, as discussed above a positive OLS bias is the case here that further suggests that if "equalizing differences" are true then this finding implies that workers' consider supervision as a 'bad' and not as a 'good' working condition.

Therefore, again as suggested by the latter argument which is based on our results on the direction of the endogeneity bias of OLS estimates, any "equalizing differences" explanations could be also dismissed, as our findings imply that if workers' preferences over supervision are important for wage determination then it is more likely for workers to"dislike" than to "like" supervision, which cannot explain the negative relationship between wages and supervision implied by our results.[209]

Thus, the above discussion may suggest that the evidence of a wage-supervision trade-off should be interpreted as supporting the hypothesis that wages and supervision intensity are effort regulating devices. The latter hypothesis is a prediction of efficiency

ers quality, as care homes is a very homogenous sector, then the combination of first differences and of inclusion of worker's quality controls should result in a positive and significant relationship between wages and supervision, provided that the 'sorting by ability' model is true (see chapter 3 for detailed explanation).

208 In other words, according to the 'equalising differences' explanation where supervision is a 'good' working condition, unobserved workers' preferences over supervision suggest a negative OLS bias.

209 Note also that again the use of first differences may net out the effect of unobserved workers' preferences on supervision which are expected to be relatively fixed.

wages or agency theories in general, of which the efficiency wage theory is a special case. An important feature of our analysis is that it addresses two of the most important empirical problems of the estimation of the wage-supervision relationship namely endogeneity bias and observational equivalence of empirical results.

Additionally, Rebitzer (4.1995) suggested that except of endogeneity another problem that may hinder the identification of the relationship between wages and supervision is measurement error as the ratio of supervisors to supervised may consistently overestimate the intensity of supervision as supervisors may not have a solely monitoring role in production.

According to this argument it may be the case that supervisors are more skilled production workers that coordinate the activities of lower-skilled workers, fact which further implies, as also emphasized by Groshen and Krueger (4.1990) and Rebitzer (4.1995) that under any production function that allows for a non-zero marginal rate of substitution between inputs, an exogenous increase in the wage (as it is the case here) will generate substitution of higher skilled workers i.e. supervisors/managers for lower skilled-non-managerial workers.

In our case the fact that we do not have accurate and detailed supervision data may suggest that measurement error is a potential problem. However, the fact that in our case measurement error concerns are related to the dependent and not the independent variable of interest and the use of first differences and of the two-stage least squares estimation are expected to abate any measurement error problem. Moreover, in this case measurement error concerns the dependent and not the independent variable, and thus if measurement error in monitoring intensity consists a valid problem in this case, then by standard econometric theory (Dougherty 2004.1) we should expect that this will lead to consistent coefficient estimates but with larger standard errors. Therefore, in our case the presence of measurement error on supervision makes our findings of a wage-supervision trade-off even more compelling.

As far as the potential substitution of supervisors for workers is concerned, this may be a problem as the minimum wage generates an exogenous increase in the wage of staff relative to those of supervisors. However, Groshen and Krueger (4.1990) suggest that as long as the wage of supervisors varies independently of that of workers, then substitution is not expected to be a problem.

In our case the situation described by Groshen and Krueger may hold as for example for the 98/99 sample we find that the average hourly wage of managerial workers is £5.5 compared to non-managerial workers for which the average hourly wage is £3.87, which combined with the recent evidence that further suggests no spill-over effects of the NMW introduction (Dickens and Manning 2004), implies that the minimum wage may generate an independent variation in the wages of non-managerial employees compared to wages of managerial employees. This latter proposition is further supported by the results (not reported here) from regressions of the change in log average hourly wage of managerial workers on the two measures of the NMW impact with or without controls for both the 4.1999 introduction and 2004.1 increase which show no significant impact of the national minimum wage on the change in average managerial wages, whereas a strongly and positive relationship is the case for non-managerial wages and measures of the minimum wage impact.

Moreover, the fact that in our previous analysis we failed to find any evidence of substitution of high for low-skilled employees in bodies or even in hours, which may be explained by the argument that no long-run effects could have taken place during the time between the NMW introduction/increase and the post-minimum data-collection, may further suggest that substitution may not be a problem in our case. Finally, if any substitution of supervisors for staff concerns remain valid even when the above conditions hold, the fact that the substitution bias is expected to be positive, makes our finding of a negative wage-supervision relationship even more compelling and suggests that our estimates of the wage-supervision trade-off are moderate estimates of the true relationship of interest.

Therefore, the evidence produced in this section provide support to a negative relationship between wages and supervision intensity across homes for the period surrounding the 4.1999 NMW introduction but no support of a wage-supervision trade-off for the period of the 2004.1 NMW increase.

The evidence from previous sections also imply that the NMW both in 4.1999 and 2004.1 was binding, as suggested both by the survey statistics presented in the previous section, where it is found that a very large proportion of employees across care homes will be affected by the NMW introduction and increase and also that in the case that wages of affected workers will be increased for employers to comply with the law this will generate considerable increases in care homes wage bill. In addition to the above evidence, the fact that in 4.1999 the NMW was introduced in a previously unregulated labour market and that the 2004.1 increase was the most generous to date (around 4.14.1% and 4.10 % increases in the adult and development rate respectively) may provide further support to the fact that the NMW had a significant 'bite' in the care homes sector and thus increased wages in the sector above the 'market-clearing' wage in this period.

Given also the estimation results presented earlier in this section and the arguments used in order to sort-out alternative theoretical explanations of the wage-supervision trade-off, the evidence of the trade-off could be interpreted as that wages and supervision are substitutes in eliciting productive behaviour by employees. Combining the latter two points the evidence could be interpreted as supporting a fundamental assumption of efficiency wages (and in particular of the "shirking" and "gift-exchange" models) that above market clearing wages generate gains in terms of employees' productivity (in this particular case savings in supervision costs).

However, the latter evidence is necessary but not sufficient to support efficiency wages as one needs also to show that the above market clearing wages were actually efficient, i.e. to show that wages 'paid for themselves' (Levine 4.1992).

A simple test of the latter hypothesis can be provided by comparing the associated benefits and costs of the higher wage, based on estimates from the 98/99 care homes sample. The marginal cost of the higher wage can be calculated as a 4.1% increase in the average wage of non-managerial, affected workers, which for the pre-introduction survey is £3.87 per hour. Thus an estimate of the marginal cost of a 4.1% increase in the wage of non-managerial employees above the initial (market clearing) wage is £0.0387 per hour, per employee.

The marginal benefit of the wage is the fall in supervision costs as we estimated that wage increases are associated with reduction in the number of managerial employees per non-managerial employee. In particular a 4.1% increase in the average wage at home is associated with a 5.2% fall in the number of managerial employees per worker.[210] Therefore, provided that the average number of managerial employees per non-managerial employee is 0.4.14.1 in the before 4.1999 introduction sample and that the average wage of managerial employees is £5.5, the fall in supervision costs generated by the 4.1% increase in the wage will be equal to £0.034.14[211] per employee, per hour, which is lower than the increase in the wage costs.

A wage-supervision trade-off estimate for which the increase in wage costs generated by the minimum wage is exactly offset by a fall in supervision costs should be around 0.7. However, in the case that the increase in the wage generates substitution of managerial for non-managerial employees, the 2SLS estimate of the wage-supervision trade-off is a moderate[212] estimate of the true wage-supervision trade-off, which further implies that it may be possible that the NMW introduction may be such that the increase in wage costs per employee is exactly or more than offset the increase in supervision costs.

All in all the evidence in this section provide support to the tenet of efficiency wages that above market-clearing wages generate gains in terms of employees productivity and

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[210] The 2SLS estimate from specification (2) of the upper panel of table 15 is not an estimate of the elasticity of supervision intensity w.r.t the wage. In particular our estimate provides that $\frac{d(N/L)}{d \ln w} = -0.57$, where N/L is the ratio of supervisors to workers and w is the wage. Therefore to derive the associated elasticity we need to divide the estimate with the sample average of the ratio of managerial to non-managerial employees, which is 0.11.

[211] Calculated as follows: 0.052*0.11*£5.5.

[212] Rebitzer (1995) also notes that in general IV estimates are moderate estimates of the true relationship of interest.

thus because of this reason a binding minimum wage may not hurt profits very much, fact which could further explain why although the minimum wage generated significant increases in wage costs across care homes, employment effects were quite moderate. This latter finding provides support to the main hypothesis of interest which suggests that because of important efficiency wages considerations in low-wage labour markets, the imposition of a binding minimum wage is not expected to generate significant increases in costs and thus undesired employment adjustments for workers or policy makers.

4.6.6 Employees Quality and Turnover

Different theoretical models of efficiency wages focus on different gains in terms of employees' productivity generated by higher wages. In the shirking. model (Stiglitz 4.1984) higher wages increase effort or reduce shirking by employees, whereas in the turnover model (Salop 4.1979) and the adverse selection model (Weiss 4.1980, 4.1990) higher wages reduce turnover and improve the average 'quality' of firm's applicants respectively.

In the previous sections we found some evidence that higher wages generated by the NMW 4.1999 introduction reduce supervision intensity and therefore supervision costs but no evidence that the NMW 4.1999 introduction and 2004.1 increase, raised effort or the intensity of work for employees in care homes. In this section we are looking for any evidence on any other employees' productivity related gains that may have been the result of the above market clearing pay generated by the NMW introduction and increase.

Tables 4.15 and 4.16 summarise estimation results of the impact of the NMW on the 'quality' and the turnover rate of the employees across care homes. According to the adverse selection model of efficiency wages, higher wages will improve the average quality of firm's applicants. Moreover, based on the turnover model, as higher wages will decrease quits and increase the recruitment rate of the firm average tenure in the firm will rise and in turn this will lead in an increase in the average stock of human capital of firm's employees.

In the upper panel of table 4.15 are summarised the results of the NMW impact on the change in average age of employees at home, where average age is viewed as a proxy of the employees' experience on the job and thus the average human capital in the care home. We find no evidence of an NMW effect on the change in the average age of employees across care homes.

Similarly the lower panel of table 4.15 presents estimates of the effect of the NMW on the average tenure of employees in care homes. Again, no evidence is produced of any significant effect of the NMW on the average tenure of employees in care homes for both the 98/99 and 01/02 samples.

Finally, table 4.16 summarises estimation results of the effects on the NMW on change in care homes quit and recruitment rate respectively. Once more, the results are uniformly insignificant across all specifications and minimum wage measures used.

Therefore, the main conclusion of this section is that we find no evidence of any other gains, as reductions in quits or increase in recruitment and in average tenure or average age of employees in care homes, resulted from the NMW introduction and increase.

4.7 Theoretical Explanation of Empirical Findings

In general theoretical models are judged by the realism of their assumptions but mainly by the accuracy by which they can explain observed phenomena. Therefore, in this section we consider as important to check whether or not our empirical findings can reconcile with the predictions of any of the theoretical models summarised in one of the previous sections.

We have to distinguish between the empirical findings of the 1999 NMW introduction and the 2004 increase in the NMW because firstly findings are different between the two periods and as second there is more information and thus we get a clearer view of the wider picture in 1999 than in 2004.

Starting with the 1999 story as suggested by the evidence produced by previous studies and complementary evidence presented in previous sections, the competitive model can explain why the NMW introduction which caused sizeable wage increases resulted in some employment reductions. However, recall that the evidence suggests that employment reductions were relatively moderate, considering how heavily the wage structure was affected by the NMW introduction (MMR 2003, MW 2004). How can this observation be explained?

Firstly, under the competitive framework the wage increase reduces employment through two channels: the substitution effect and the scale effect. As far as any substitution effect is concerned, as discussed in previous sections it is quite likely that the survey design (the timing of the post-introduction survey) is such that doesn't allow us to identify any long-run effects as that of substitution, because these effects usually need more time to take place, but even if these adjustments have taken place we cannot find any evidence of an increase in capital or skilled labour utilisation relative to unskilled labour. Therefore, based on the above arguments and evidence and under the competitive model it is likely that the fall in employment is solely due to the scale effect of a higher wage.

If the minimum wage decreased employment at the firm level, the competitive model predicts a fall in industry's output and an increase in industry prices. In particular, an increase in the price and a quite small elasticity of industry's product demand can explain a small decrease in output and employment under such significant increase in wages.

We find no evidence of price changes for the 98/99 period, which is something not surprising, given the information that local authorities capped prices in the care homes industry for the period of the 1999 NMW introduction (MMR 2003). Thus, under the above conditions, where prices were unchanged and if the care homes operate in a competitive labour market, we would expect a dramatic fall in output and employment which is not the case here according to the evidence.

Finally, as wages increased substantially, prices were capped and employment and output didn't fall dramatically, and provided that we find no evidence of other offsets of increased costs in terms of substitution, effort and output per employee, the competitive model would predict a dramatic fall in profits but also a fall in the number of firms in the long-run for the care homes industry. We observe neither of this to be the case after the 1999 NMW introduction. This analysis suggests that the competitive model and its variants cannot offer a satisfactory explanation of our findings on the effects of the 1999 NMW introduction in the care homes sector.[213]

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[213] A summary of the findings of MMR (2003) and MW (2004) is very similar, at least qualitatively to the findings presented in this chapter and thus it is expected that it would produce a similar story.

Moreover, the evidence of a fall in supervision intensity as a result of the NMW introduction could be explained by the competitive model only if supervision is considered by workers a non-pecuniary work benefit, but our evidence doesn't seem to support this hypothesis.

The models that assume wage-setting power can also explain the small employment fall observed in 1999 that is the result of the NMW introduction, if the increase in the marginal cost of labour in the short run is higher than the marginal revenue product of labour. In particular, the models of oligopsony and monopsonistic competition (Bhaskar and To 1999, Bhaskar, To and Manning 2004.1) can account for a moderate negative employment effect of the minimum wage as they predict two counteracting effects of the minimum wage increase, a standard positive employment effect which is the result of upward sloping labour supply at the firm level and a negative employment effect through exit of firms that operates via the reduction in profits resulted by the wage increase.[214]

However, in this case the negative employment effect of the NMW cannot be explained in terms of exit of care homes as firstly we find no evidence of a fall in profits and closures in the long-run but more importantly because it is unlikely that any exit adjustments took place between the NMW introduction in April 1999 and May 1999 when the post-introduction data-collection was conducted. The only explanation of the fall in employment and output that could be provided based on the theoretical models of monop-

[214] Walsh (2003) showed that the short-run employment gains are less than offset by the exit effect in the Bhaskar and To model and thus employment unambiguously increases after the minimum wage increase. However, Bhaskar and To (2004) show that in their model, under Dixit-Stiglitz (1979) specification of employees' preferences, employment unambiguously falls as a result of the minimum wage increase.

sonistic competition is that the wage increase was sufficiently high so that employment fell because the marginal cost of labour exceeded the marginal revenue product of labour.[215]

Furthermore, based on the predictions of models of wage-setting power, the fall in employment and output should be followed by an increase in prices, which is not the case here as prices are capped by local authorities. Therefore, as in the case of the competitive model, given the capped prices and the evidence that suggest no other offsets,[216] monopsony and oligopsony models would predict a substantial fall in profits in the short-run and exit in the long-run which is not the case here as suggested by the evidence.[217]

Therefore one could also claim that any of the theoretical models of the monopsony type are unable to produce a consistent story that could explain the findings from the 1999 NMW introduction.

We believe that efficiency wages models could possibly explain the observed findings from the analysis of the1999 NMW introduction. In particular, the extended version of the Rebitzer and Taylor model developed in chapter two can explain the moderate reduction in the number of employees and the number of weekly hours in the care home sector observed after the 1999 NMW introduction. This can be mainly explained by the operation of the two counteracting employment effects of the minimum wage, the 'direct' wage effect which is

[215] This is a prediction produced also by the simple monopsony model.

[216] Under the simple monopsony framework if the minimum wage increases employment at the firm level in the short-run, it will also induce substitution of labour for capital and other inputs in the long-run, but if the minimum wage decreases employment then the substitution effect on labour is negative. Thus, static monopsony can be consistent with the fall in employment observed in 1999, although not consistent with the evidence that find no substitution effect. However, the lack of any evidence on substitution may be possibly explained by the argument that the timing of the before and after data collection does not allow for any long-run adjustments to take place.

[217] Based on Zavodny (1999), even when profits fall substantially because of the minimum wage change and the fact that prices are remaining fixed, exit may not be the case if the product market is imperfectly competitive and allows firms to earn positive profits just before the minimum wage increase.

positive and the 'supervision' effect which is negative. Moreover, the higher wage will increase motivation and effort and thus supervision can be relaxed. Provided that the fall in supervision is such that exactly offsets the increase in effort generated by the higher wage, our theoretical model also reconciles with the evidence that the ratio of managerial to non-managerial employees falls as a result of the minimum wage introduction, whereas effort is unchanged.

Given that effort is unchanged and that industry's employment falls, industry's output is expected to fall as well and industry's price to rise. The evidence seems to support the above predictions, except of the fact that prices were unchanged which can be explained by local authorities regulation.

Finally, our theoretical model could reconcile with the evidence that the NMW introduction had no effect on profits in the short-run and closures in the long-run, as it predicts that a higher wage has only a (negative) second-order effect on firm's profits as the increased wage costs are offset by a fall in supervision costs. In one of the previous sections we find some evidence that the increase in wage costs per non-managerial employee is more or less exactly offset by a fall in supervision costs resulting by the fall in the number of managerial employees needed to monitor a non-managerial employee. This offset in combination with the fact that prices were unchanged can explain why the NMW 1999 introduction had no effect on profits and closures in the care homes sector.

Therefore, the evidence seems to provide some support not only on the prediction of a wage-supervision trade-off produced by the theoretical model of chapter two but also on the rest of the predictions of the model, if one assumes that the partial equilibrium analysis is extended in general equilibrium for a perfectly competitive industry, regarding employment, effort, output, profits and exit. In general, the above discussion also explains how our theoretical framework can provide a satisfactory explanation of the general findings on the effects of the 1999 NMW introduction in the care homes industry.

The effects of the 2004.1 NMW increase as presented by our findings are more difficult to be discussed in terms of the theory as the lack of sufficient information makes the findings on profits and output less reliable compared to the 98/99 sample. Furthermore, there is no information and no study has been produced up to now on any exit or entry effects of the 2004.1 NMW increase. However, we will try to look whether or not even this incomplete picture can be explained by any of the seminal theoretical models used in the analysis of the economic effects of minimum wages.

In particular, we find that wage increases caused by the October 2004.1 minimum wage increase is even higher than those resulted from the 1999 introduction. Although, we find a significant increase in wage costs to be the case in 2004.1, we fail to find any negative employment effects, as evidence suggest a non-significant relationship between the minimum wage impact and employment. Moreover, we also find no evidence of substitution of capital and higher skilled labour and no evidence of a change in (subjective) effort, as a result of the 2004.1 NMW increase.

As discussed also above the competitive model predicts two effects of the higher wages costs generated by the minimum wage increase on employment, the scale and the substitution effect. Provided here that no substitution effect is observed, the scale effect could explain the zero employment effect observed here only if the product demand is perfectly inelastic with respect to price so that the increase in price exactly offsets the increase in costs generated by the minimum wage increase and leads to no reduction in output and employment at the industry level. Thus, this quite extreme case could explain the result obtained, given that what we observe are short-run responses to the minimum wage.

As far as oligopsony and monopsonistic competition models is concerned and provided that the observed findings capture only short-run adjustments to the minimum wage, the evidence that the NMW increase had no effect on employment whereas caused price increases could be possibly explained in the case where the NMW sets the marginal cost of labour at a level equal to the marginal revenue product of labour, and where firms have product market power and thus although employment is not affected in the short-run prices are increased in order to offset the higher costs. However, under this case we would expect a fall in industry's output. Unfortunately we do not have sufficient information on output measures in order to check whether this prediction is borne out.

Our theoretical efficiency wages model can explain the observed findings from the 04.1/02 sample of care homes, even in the case that these are the results of short-run adjustments only, as it allows for the case where the NMW doesn't change employment as the 'direct wage' and 'supervision' effect are counteractive and the one exactly offsets the other.

However, as the evidence of the economic effects of the 2004.1 NMW increase is incomplete, as also discussed above, one cannot get a clear overview of the effects of the NMW increase that allows an investigation of which theoretical model better explains the evidence and therefore more evidence is needed in order to test the relative usefulness of theoretical models in explaining the economic effects of the 2004.1 NMW increase.

4.8 Conclusions

The main objective of this chapter is to empirically test the validity of efficiency wages theory exploiting a quasi-natural experiment from a low-wage labour market, the UK residential care homes industry, provided by the 1999 introduction and 2004.1 increase in the UK National Minimum Wage. The imposition of a binding minimum wage in general offers an ideal research design to test the validity of efficiency wages as the essence of efficiency wages is that above market clearing wages are generating gains in terms of employees' productivity. This ideal research design offers the opportunity to test one of the main predictions of the 'shirking' and 'gift-exchange' models of efficiency wages, that in equilibrium an increase in the wage will cause a fall in supervision intensity, ceteris paribus. This test enables us also to test the validity of the extended version of the Rebitzer and Taylor shirking model we developed in chapter 2, and in general allows us also to test the main premise of the thesis that there exist valid efficiency wages considerations in low-wage labour markets.

Our main contribution is that we address the main empirical problems, namely endogeneity, measurement error and observational equivalence, that hinder the estimation of the wage-supervision relationship. Probably the most important problem, that makes the empirical testing of efficiency wages particularly vexing and seems to be neglected in the literature, is that overcoming the main empirical problems and producing evidence that supports a wage-supervision trade-off is a necessary but not sufficient condition for the validity of efficiency wage theory.

Although, the central tenet of efficiency wages that suggests that above market-clearing wages affect workers' productive behaviour, the second fundamental feature of efficiency wages is that, the above-market clearing setting of wages is done in an efficient, profit-maximising way. Therefore we also exploit the nature of the minimum wage introduction into a previously unregulated labour market and the evidence of a wage-supervision trade-off produced for the 1999 NMW increase to test the latter condition of efficiency wages.

We find that wage increases generated by the 1999 NMW introduction reduced the intensity of supervision in the care homes industry, and thus this finding provides support to the efficiency wages theoretical rationale that wages and supervision are substitutes in regulating employees effort. This finding can be interpreted as indirect evidence of wage effects on workers' productive behaviour. Moreover, we also find that the increase in wage above the market clearing level produced by the introduction of a binding minimum wage in a previous unregulated low-wage industry, was more or less exactly offset by the fall in supervision costs. This latter finding combined with the first finding that supports the productivity augmenting property of higher wages provide support to efficiency wages and thus also to the central premise of the thesis that efficiency wages may be particularly valid in low-wage labour markets, where the minimum wage is binding.

The latter result has important policy implications and suggests that efficiency wages may provide valuable insight into how low-wage labour markets operate. In order to further test the latter conjecture we also estimate the effects of the 1999 and 2004.1 NMW introduction on wages, employment, profits, output, and the effects of the 2004.1 NMW increase on prices, effort and productivity, as empirical evidence can be further used to check the usefulness of our efficiency wages theoretical model in explaining the evidence on the economics effects of the minimum wage in a low-wage labour market, the UK residential care homes industry.

In sum, we find that the NMW increased wages in both 1999 and 2004.1 but the 2004.1 wage effects are larger in contrast to the findings of Machin and Wilson (2004) who found higher effects for the 1999 introduction. Moreover, although wages increased significantly as a result of the NMW introduction and increase, we find some evidence of relative moderate employment reductions for the 1999 and no employment effects for the 2004.1 period.

Our analysis finds that prices have increased after the 2004.1 NMW increase and thus were not capped by local authorities as it was the case for the 1999 NMW introduction. Moreover, profits weren't affected in either the period of the introduction or of the increase. We also find no evidence of any NMW effects on long-run outcomes such factors substitution for both periods, with the latter being explained mainly by the fact that it is unlikely that substitution have taken place within a period of two or three months after the policy, when the 'post-treatment' surveys have been conducted. Finally, except of the evidence in support of a wage-supervision trade-off produced for the 1999 NMW introduction we also find some evidence that output fell in 1999 and that effort based on subjective employers' responses has remain unchanged in 2004.1.

The above evidence of the effects of the NMW on the main economic outcomes in the care homes industry can provide a wider picture of the effects of the policy that seems to be better explained by efficiency wages models and in particular the suitably extended shirking model that treats supervision intensity as endogenous, developed in chapter 2.

As the evidence are produced using data from one of the lowest paying labour industries in the UK, that of care homes, we may claim that we find some support to the hypothesis that there are valid efficiency wages considerations in low wage labour markets, a finding that is made even more appealing by the fact that our shirking efficiency wages model of chapter 2 reconciles with some of the main empirical findings of this chapter on the economic effects of the NMW 1999 and 2004.1 increase. Therefore, overall our findings in this chapter seem to provide further support to the validity of the main tenet of our thesis that efficiency wage theory could shed much light into the working of low-wage labour markets.

4.9 Tables

Table 4.1: Summary of Theoretical Predictions

Labour Market		Perfect Competition		Monopsony (Static and Dynamic)		Monopsonistic Competition (Oligopsony)		Efficiency Wages
Product Market		Competition	Market Power	Competition	Market Power	Competition	Market Power	Competition
Firm's (Industry) Wage		increases	increases	increases	increases	increases	increases	increases
Firm-level Employment (output)	Short-run (SR)	falls	falls	increases	increases	increases	increases	increases or falls
	Long-run (LR)	falls	falls	increases	increases	increases or falls	increases or falls	increases or falls
Aggregate Employment (output)	SR	falls	falls	increases	increases	increases	increases or constant	increases or falls
	LR	falls	?	falls	increases	ambiguous	ambiguous or falls	increases or falls
Price	SR	increases	increases	falls	falls	falls	falls or constant	increases or falls
	LR	increases	?	increases	falls	ambiguous	ambiguous or increases	increases or falls
Profits	SR	fall	fall	fall	fall	fall	fall	increases or fall
	LR	constant	?	constant	?	constant	?	constant
Number of Firms		ambiguous	?	falls	?	falls	falls	ambiguous

Notes: Question mark suggests that there are no clear predictions of the effect of the introduction/increase in the minimum wage on the particular outcome.

Table 4.2: July 1998/May 1999 Survey Descriptive Statistics

	All Firms		Balanced Panel	
	Pre-Minimum	Post-Minimum	Pre-Minimum	Post-Minimum
Number of Homes	548	579	195	195
Number of Workers	14.93 (10.61)	16.67 (39.12)	14.36 (9.16)	14.56 (9.41)
Hourly Wage (None imputed)	4.065 (1.098)	4.364 (1.229)	4.055 (0.71)	4.17 (0.51)
Hourly Wage (With imputed)	4.069 (1.091)	4.362 (1.219)	4.003 (1.031)	4.18 (0.52)
Weekly Hours (None imputed)	24.64 (11.33)	24.74 (11.02)	23.751 (11.437)	24.03 (11.24)
Weekly Hours (With imputed)	24.69 (11.22)	24.71 (10.74	23.753 (11.323)	23.05 (7.24)
Weekly Earnings (None imputed)	102.06 (61.86)	109.67 (68.32)	96.31 (39.42)	98.01 (31.08)
Weekly Earnings (With Imputed)	102.59 (61.09)	110.44 (66.82)	96.61 (58.07)	99.03 (31.03)
Proportion of Workers with missing information	0.11	0.098	0.045	0.086
Proportion Female	0.89	0.9	0.91	0.90
Average Age	40.44 (7.12)	40.84 (7.45)	40.46 (7.23)	40.58 (7.57)
Proportion Care Assistants	0.63	0.62	0.63	0.64
Proportion With Nursing Qualification	0.1	0.11	0.12	0.12
Number of Beds	17.74 (10.06)	19.94 (29.87)	16.93 (9.25)	17.3 (9.54)
Number of Residents	15.33 (9.25)	18.00 (28.42)	14.67 (8.23)	15.21 (8.54)
Occupancy Rate	0.85	0.88	0.86	0.87
Average Weekly Price per Bed	252.45 (79.23)	253.8 (79.27)	252.83 (84.97)	254.42 (79.00)
Proportion DSS/Local Authority	0.49	0.53	0.47	0.5
Supervision Intensity	0.11	0.13	0.11	0.126

Notes: Standard errors in parentheses. Pre-minimum and post-minimum statistics are calculated using observations from the pre-NMW introduction and post-NMW introduction sample. All averages are calculated across homes. Supervision intensity is calculated as the ratio of managerial to non-managerial employees at home. The occupation of care assistants includes senior, day and junior carers but exclude night carers and sleep-ins.

Table 4.3: August 2001/February 2002 Survey Descriptive Statistics

	All Firms		Balanced Panel		Balanced Panel (Excluding firms with a lot of missing worker information)	
	Pre-Minimum	Post-Minimum	Pre-Minimum	Post-Minimum	Pre-Minimum	Post-Minimum
Number of Homes	411	333	152	152	130	130
Number of Workers	15.93 (10.36)	15.70 (9.64)	15.15 (8.75)	15.36 (9.28)	15.45 (8.91)	15.74 (9.40)
Hourly Wage (None imputed)	4.691 (1.244)	4.816 (1.285)	4.686 (1.237)	4.84 (1.21)	4.702 (1.259)	4.85 (1.25)
Hourly Wage (With imputed)	4.695 (1.236)	4.840 (1.307)	4.684 (1.228)	4.85 (1.23)	4.700 (1.254)	4.870 (1.27)
Weekly Hours (None imputed)	26.232 (11.451)	25.85 (11.62)	25.640 (11.445)	25.58 (11.57)	25.72 (11.42)	25.83 (11.62)
Weekly Hours (With imputed)	26.271 (11.302)	25.88 (11.38)	25.658 (11.191)	25.68 (11.33)	25.75 (11.28)	25.92 (11.36)
Weekly Earnings (None imputed)	125.99 (73.54)	126.37 (72.05)	123.69 (75.32)	125.65 (73.78)	124.00 (75.79)	127.05 (74.95)
Weekly Earnings (With Imputed)	126.57 (72.55)	127.5 (72.31)	123.85 (73.62)	128.07 (74.38)	124.30 (74.94)	129.57 (75.63)
Proportion of Workers with missing information	0.13	0.099	0.11	0.10	0.025	0.081
Proportion Female	0.86	0.88	0.9	0.88	0.90	0.87
Average Age	40.84 (7.00)	42.16 (6.71)	41.638 (6.32)	41.94 (6.17)	41.21 (6.26)	41.66 (5.95)
Proportion Care Assistants	0.55	0.61	0.605	0.63	0.61	0.63
Proportion With Nursing Qualification	0.023	0.02	0.023	0.022	0.025	0.022
Number of Beds	20.44 (35.28)	18.61 (29.87)	18.56 (18.14)	17.70 (8.60)	18.93 (20.19)	18.01 (8.95)
Average Weekly Price per Bed	285.76 (97.52)	281.33 (99.69)	279.013 (76.53)	287.00 (90.47)	282.42 (75.84)	291.66 (93.90)
Proportion DSS/Local Authority	0.48	0.46	0.48	0.45	0.497	0.467
Supervision Intensity	0.076	0.076	0.09	0.074	0.089	0.077

Notes: Standard errors in parentheses. Pre-minimum and post-minimum statistics are calculated using observations from the pre-NMW introduction and post-NMW introduction sample. All averages are calculated across homes. The last two columns include homes in the balanced sample with less than half workers information missing. Supervision intensity is calculated as the ratio of managerial to non-managerial employees at home. The occupation of care assistants includes senior, day and junior carers but exclude night carers and sleep-ins.

Table 4.4: The "Bite" of the 1999 National Minimum Wage Introduction

	98/99			
	All Firms		Balanced Panel	
	Pre-Minimum	Post-Minimum	Pre-Minimum	Post-Minimum
% Paid Less Than Their Age-Specific Minimum Wage	23	0.66	21	0.75
% Paid Less Than The Adult Minimum Wage (only covered workers are considered)	29	1.8	28.8	2.2
% Paid Less Than The Adult Minimum Wage (all workers)	30	3.3	30.5	4
Wage Gap	0.024	0.0012	0.019	0.0007
% Paid Exactly Their Age Specific Minimum Wage	7.9	19.8	8.6	20
% Paid Exactly The Adult Minimum Wage (only covered workers)	8.1	22.6	8.7	22.6
% Paid Exactly the Adult Minimum Wage (all workers)	8.8	24	9.2	23.8
Number of Homes	548	579	195	195

Notes: The age specific National Minimum Wage is £3.6 per hour for those above 21 years old (the adult rate) and £3 per hour for those between 18 and 21 inclusive and also including those that are above 21 who are undertaking formal training and who are in the first six months of employment (the development rate). The wage gap variable indicates the proportional increase in the weekly wage bill if the wages of those affected were increased to their age specific minimum rate.

Table 4.5: The "Bite" of the National Minimum Wage 2001 increase

	All Firms		Balanced Panel		Balanced Panel (Excluding firms with a lot of missing worker information)	
	Pre-Minimum	Post-Minimum	Pre-Minimum	Post-Minimum	Pre-Minimum	Post-Minimum
% Paid Less Than Their Age- Specific Minimum Wage	22.3	1.7	19	1.4	20.1	1.4
% Paid Less Than The Adult Minimum Wage (only covered workers are considered)	25.2	2.7	21.5	2.1	23	2.2
% Paid Less Than The Adult Minimum Wage (only covered workers)	29.1	4.6	25.7	4.06	26.7	4.06
Wage Gap	0.0153	0.0052	0.0135	0.0038	0.0134	0.0043
% Paid Exactly Their Age Specific Minimum Wage	4.1	18.2	4.1	16.1	4.5	15.7
% Paid Exactly The Adult Minimum Wage (only covered workers)	4.2	18.1	4.4	16.8	4.9	16.7
% Paid Exactly the Adult Minimum Wage (all workers)	4.7	19.5	4.6	17.7	5.09	17.4
Number of Homes	411	333	152	152	130	130

Notes: The age specific National Minimum Wage is £4.1 per hour for those above 21 years old (the adult rate) and £3.5 per hour for those between 18 and 21 including those that are above 21 who are undertaking formal training and who are in the first six months of employment (the development rate). The wage gap variable indicates the proportional increase in the weekly wage bill if the wages of those affected were increased to their age specific minimum rate.

Table 4.6: The Effects of the UK National Minimum on Home Level Average Hourly and Average Weekly Wages

Change in log Hourly Wage								
	98/99				01/02			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
% Low-paid	0.12 (0.024)	0.13 (0.027)			0.26 (0.048)	0.26 (0.05)		
Wage gap			1.16 (0.18)	1.16 (0.19)			3.69 (0.61)	3.7 (0.60)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.12	0.18	0.18	0.24	0.18	0.31	0.21	0.36
Number of Homes	182	182	182	182	134	134	134	134
Change in log Weekly Wage								
	98/99				01/02			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
% Low-paid	0.08 (0.069)	0.098 (0.076)			0.17 (0.1)	0.14 (0.1)		
Wage gap			0.49 (0.53)	0.42 (0.56)			2.44 (1.29)	2.28 (1.26)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.008	0.1	0.0048	0.097	0.02	0.22	0.026	0.23
Number of Homes	182	182	182	182	134	134	134	134

Notes: Standard errors in parentheses. Controls include: proportion female, average age, proportion with nursing qualification, proportion of la/dss residents and county dummies, as well as missing values dummies for proportion of la/dss residents and for average age for both the 98/99 and the 01/02 samples (missing values were imputed with sample means).

Table 4.7: The Effects of the UK National Minimum Wage on Home Level Number of Employees and on Total Weekly Hours

Change in log Number of Employees								
	98/99				01/02			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
% Low-paid	-0.28 (0.1)	-0.33 (0.11)			0.17 (0.22)	0.15 (0.23)		
Wage gap			-1.01 (0.8)	-1.05 (0.86)			0.55 (2.64)	-0.031 (2.8)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.038	0.089	0.0085	0.077	0.004	0.093	0.0003	0.088
Number of Homes	194	194	188	188	148	148	141	141
Change in log Total Weekly Hours								
	98/99				01/02			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
% Low-paid	-0.23 (0.15)	-0.19 (0.17)			0.18 (0.25)	0.17 (0.27)		
Wage gap			-1.74 (1.23)	-1.44 (1.33)			1.48 (3.23)	0.82 (3.4)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.012	0.063	0.01	0.063	0.004	0.07	0.0016	0.07
Number of Homes	185	185	185	185	135	135	135	135

Notes: Standard errors in parentheses. Controls include: proportion female, average age, proportion with nursing qualification, proportion of la/dss residents and county dummies, as well as missing values dummies for proportion of la/dss residents and for average age for both the 98/99 and the 01/02 samples (missing values were imputed with sample means).

Table 4.8: The Effects of the National Minimum Wage on Average Weekly Price of Bed

Change in the log average weekly price of bed				
	01/02			
	(1)	(2)	(3)	(4)
%Low-paid	0.22 (0.077)	0.2 (0.08)		
Wage gap			2.19 (0.91)	2.16 (0.96)
Controls	No	Yes	No	Yes
R-squared	0.056	0.13	0.04	0.14
Number of Homes	142	142	135	135

Notes: Standard errors in parentheses. Controls include: proportion female, average age, proportion with nursing qualification, proportion of la/dss residents and county dummies, as well as missing values dummies for proportion of la/dss residents and for average age for both the 98/99 and the 01/02 samples (missing values were imputed with sample means).

Table 4.9: The Effects of the UK National Minimum Wage on Weekly trading surplus rate of Care Homes

Change in Weekly Trading Surplus Rate								
	98/99				01/02			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
%Low-paid	0.02 (0.22)	0.31 (0.24)			-0.37 (0.76)	-0.39 (0.55)		
Wage gap			0.012 (1.71)	0.84 (1.89)			-7.02 (9.09)	-5.15 (7.4)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.0001	0.093	0.0001	0.096	0.0021	0.55	0.004	0.55
Number of Homes	150	150	144	144	117	117	112	112

Notes: Standard errors in parentheses. Controls include: proportion female, average age, proportion with nursing qualification, proportion of la/dss residents and county dummies, as well as missing values dummies for proportion of la/dss residents and for average age for both the 98/99 and the 01/02 samples (missing values were imputed with sample means). Weekly trading surplus rate is calculated as weekly revenue (average weekly price of bed times number of residents minus total costs (total labour costs calculated as the total weekly wage bill divided by the proportion of labour costs in total costs) and all this divided by weekly revenue. Because of lack of information on the number of residents in 01/02 sample, trading surplus was calculated as described above but using the number of beds instead of the number of residents.

Table 4.10: The Effects of the UK National Minimum Wage on Measures of Capital/Labour Ratio

Change in log Number of Beds per Employee								
	98/99				01/02			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
% Low-paid	0.16 (0.089)	0.19 (0.1)			-0.16 (0.18)	-0.2 (0.18)		
Wage gap			0.57 (0.69)	0.55 (0.75)			-1.09 (2.15)	-0.7 (2.26)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.018	0.065	0.0037	0.076	0.0056	0.14	0.0019	0.14
Number of Homes	192	192	186	186	148	148	141	141
Change in log Number of Beds per Weekly Hour								
	98/99				01/02			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
% Low-paid	0.21 (0.11)	0.19 (0.12)			-0.19 (0.2)	-0.22 (0.21)		
Wage gap			1.2 (0.87)	1.06 (0.92)			-1.39 (2.66)	-0.89 (2.71)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.019	0.096	0.01	0.09	0.0063	0.13	0.002	0.13
No of Homes	183	183	183	183	135	135	135	135

Notes: Standard errors in parentheses. Controls include: proportion female, average age, proportion with nursing qualification, proportion of la/dss residents and county dummies, as well as missing values dummies for proportion of la/dss residents and for average age for both the 98/99 and the 01/02 samples (missing values were imputed with sample means).

Table 4.11: The Effects of the UK National Minimum Wage on High to Low Skilled Employees Ratio

Change in ratio of Employees with Nursing Qualification to those with no Qualification								
	98/99				01/02			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
%Low-paid	0.026 (0.24)	-0.006 (0.22)			0.014 (0.023)	-0.001 (0.018)		
Wage gap			-0.42 (1.9)	-0.52 (1.9)			0.147 (0.26)	0.09 (0.19)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.0001	0.35	0.0003	0.35	0.002	0.51	0.002	0.54
Number of homes	182	182	178	178	148	148	141	141

Notes: Standard errors in parentheses. Controls include: proportion female, average age, proportion with nursing qualification, proportion of la/dss residents and county dummies, as well as missing values dummies for proportion of la/dss residents and for average age for both the 98/99 and the 01/02 samples (missing values were imputed with sample means).

Table 4.12: The Effects of the UK National Minimum Wage on Output

Change in log Number of Residents								
	98/99				01/02			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
% Low-paid	-0.155 (0.084)	-0.17 (0.095)			0.17 (0.3)	0.34 (0.3)		
Wage gap			-0.76 (0.67)	-0.84 (0.72)			2.27 (3.8)	2.29 (3.84)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.017	0.065	0.007	0.064	0.0024	0.19	0.0028	0.18
Number of Homes	192	192	186	186	131	131	124	124
Change in log Number of Beds								
	98/99				01/02			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
% Low-paid	-0.11 (0.075)	-0.132 (0.085)			0.007 (0.17)	-0.043 (0.18)		
Wage gap			-0.43 (0.59)	-0.47 (0.65)			-0.54 (2.0)	-0.82 (2.13)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.013	0.037	0.003	0.032	0.0001	0.07	0.0005	0.07
Number of Homes	192	192	186	186	148	148	141	141

Notes: Standard errors in parentheses. Controls include: proportion female, average age, proportion with nursing qualification, proportion of la/dss residents and county dummies, as well as missing values dummies for proportion of la/dss residents and for average age for both the 98/99 and the 01/02 samples (missing values were imputed with sample means). For the 01/02 sample because of lack of information on the number of residents the number of la/dss residents was used instead.

Table 4.13: The Effects of the UK National Minimum Wage on Labour productivity and Subjective Effort

Change in the log number of residents per employee				
	01/02			
	(1)	(2)	(3)	(4)
%Low-paid	-0.15 (0.28)	0.059 (0.28)		
Wage gap			-1.41 (3.63)	0.0049 (3.64)
Controls	No	Yes	No	Yes
R-squared	0.0022	0.18	0.0012	0.17
Number of Homes	131	131	124	124
Change in the log number of residents per weekly hour				
	(1)	(2)	(3)	(4)
%Low-Paid	-0.24 (0.27)	-0.09 (0.28)		
Wage gap			-2.59 (3.71)	-1.06 (3.77)
Controls	No	Yes	No	Yes
R-squared	0.006	0.14	0.004	0.14
Number of Homes	119	119	119	119
Change in subjective effort				
	(1)	(2)	(3)	(4)
% Low-Paid	-0.13 (0.41)	-0.41 (0.48)		
Wage gap			-5.1 (5.14)	-8.00 (5.98)
Controls	No	Yes	No	Yes
Prob>Chi-squared (LR)	0.75	0.45	0.32	0.39
No of Homes	131	131	125	125

Notes: Standard errors in parentheses. In the upper and middle panel we use the standard controls we use throughout all regressions, whereas in the lower panel we include also separation and recruitment rate and average tenure as well as missing value dummies for these variables. Iinformation on [illegible] residents is used in the calculation of productivity ratios because of lack of information on the actual number of residents. The lower panel presents ordered probit estimates, where the effort variable is coded as an ordered response with values 0 if effort is reported to fall, 1 if effort doesn't change and 2 if effort reported to increase.

Table 4.14: OLS versus 2SLS Estimates of the Wage Elasticity of Supervision Intensity

Change in the ratio of managerial to non-managerial employees								
	98/99				01/02			
	(1)		(2)		(1)		(2)	
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Change in log average wage	0.13 (0.08)	0.0035 (0.24)	-0.14 (0.1)	-0.57 (0.28)	0.24 (0.07)	-0.004 (0.17)	0.23 (0.086)	0.016 (0.2)
Controls	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.012	0.0001	0.37	0.37	0.07	0.0001	0.11	0.07
Number of Homes	178	190	142	147	133	145	131	138
Change in the ratio of managerial to non-managerial employees								
	98/99				01/02			

Table 4.15: The Effects of the UK National Minimum Wage on Average Age and Average Tenure of Employees

	Change in log Average Age							
	98/99				01/02			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
% Low-paid	0.035 (0.039)	0.019 (0.042)			0.04 (0.052)	0.016 (0.05)		
Wage gap			0.043 (0.3)	0.002 (0.31)			0.056 (0.64.)	-0.41 (0.63)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.0045	0.083	0.0001	0.083	0.012	0.14	0.0001	0.1
Number of Homes	183	183	180	180	138	138	133	133
	Change in log Average Tenure							
	98/99				01/02			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
% Low-paid	0.17 (0.1)	0.16 (0.11)			0.035 (0.18)	0.14 (0.19)		
Wage gap			1.24 (0.79)	1.14 (0.85)			1.49 (2.19)	2.62 (2.28)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.015	0.079	0.013	0.074	0.0003	0.11	0.0034	0.12
Number of Homes	187	187	184	184	143	143	138	138

Notes: Standard errors in parentheses. Controls include: proportion female, average age (included only in the average tenure regressions), proportion with nursing qualification, proportion of la/dss residents and county dummies, as well as missing values dummies for proportion of la/dss residents and for average age for both the 98/99 and the 01/02 samples (missing values were imputed with sample means).

Table 4.16: The Effects of the UK National Minimum Wage on Quit and Recruitment Rate

Change in Quit Rate								
	98/99				01/02			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
% Low-paid	0.081 (0.05)	0.043 (0.055)			-0.012 (0.058)	-0.024 (0.061)		
Wage gap			0.27 (0.4)	0.065 (0.4)			-0.076 (0.62)	0.27 (0.64)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.013	0.13	0.0026	0.19	0.0003	0.1	0.0009	0.12
Number of Homes	184	184	178	178	148	148	141	141
Change in Recruitment Rate								
	98/99				01/02			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
% Low-paid	0.03 (0.08)	0.03 (0.055)			0.034 (0.06)	0.035 (0.07)		
Wage gap			0.39 (0.63)	0.2 (0.6)			0.37 (0.78)	0.69 (0.83)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.0061	0.14	0.0022	0.23	0.0018	0.082	0.0016	0.092
Number of Homes	187	187	181	181	148	148	141	141

Notes: Standard errors in parentheses. Controls include: proportion female, average age, proportion with nursing qualification, proportion of la/dss residents and county dummies, as well as missing values dummies for proportion of la/dss residents and for average age for both the 98/99 and the 01/02 samples (missing values were imputed with sample means). The quit and recruitment rates are calculated using information on the number of employees left and the number of employees recruited in the last three months from the time of each survey.

4.10 Figures

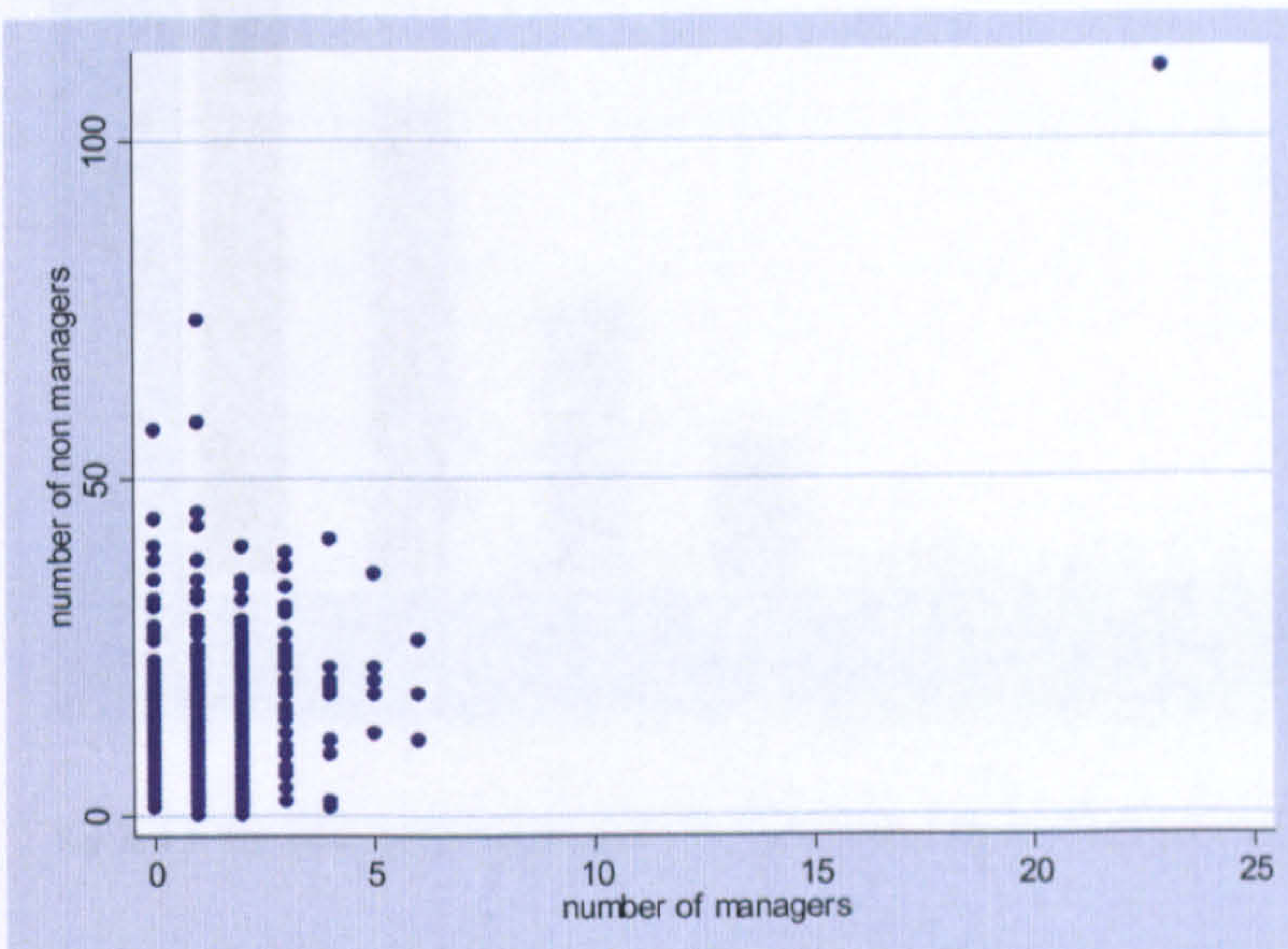

Figure 4.1: The scatter plot of the number of managers of the whole before 1999 NMW introduction care homes sample.

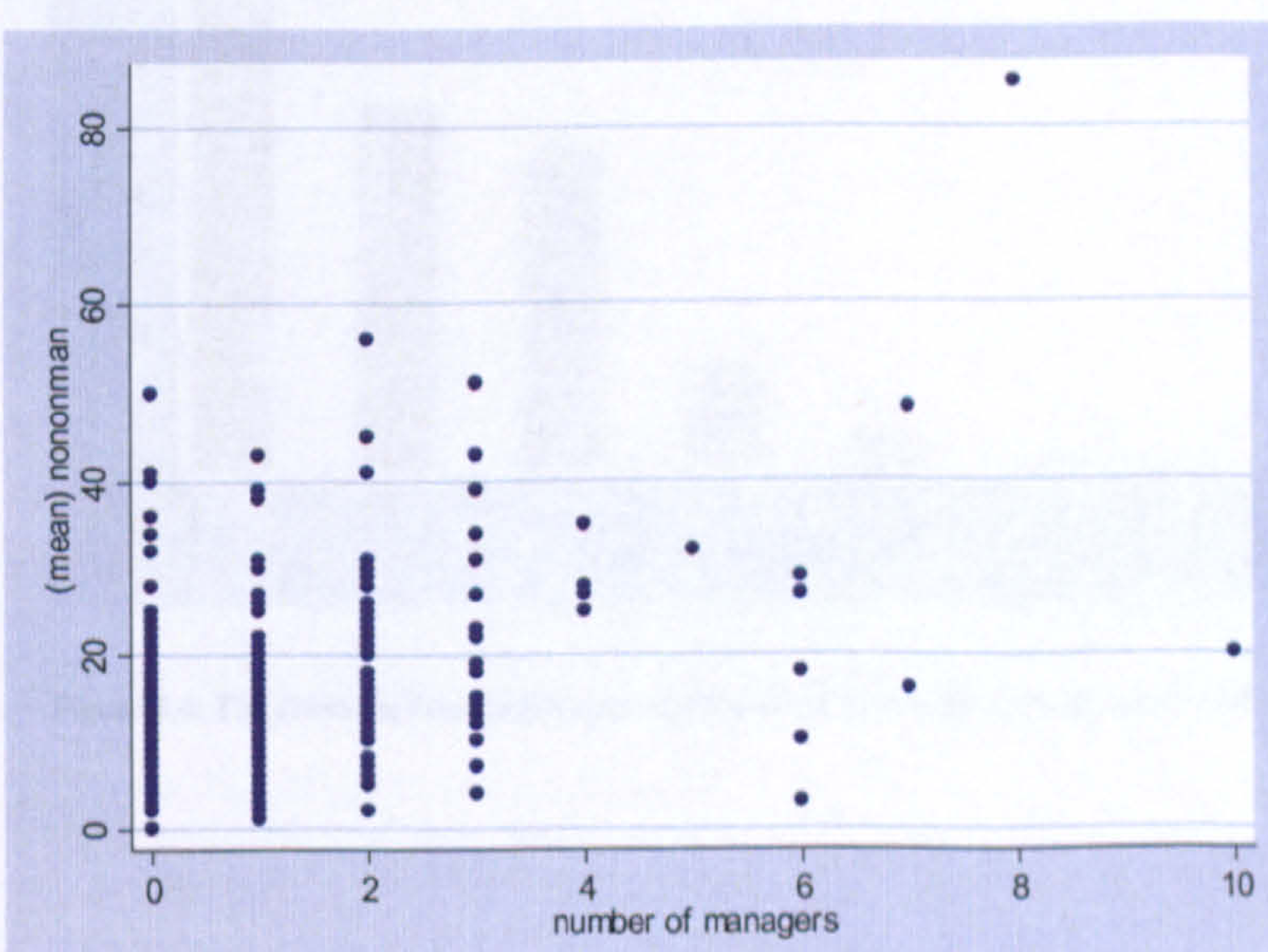

Figure 4.2: The scatter plot of the number of managers of the whole before 2001 NMW increase care homes sample.

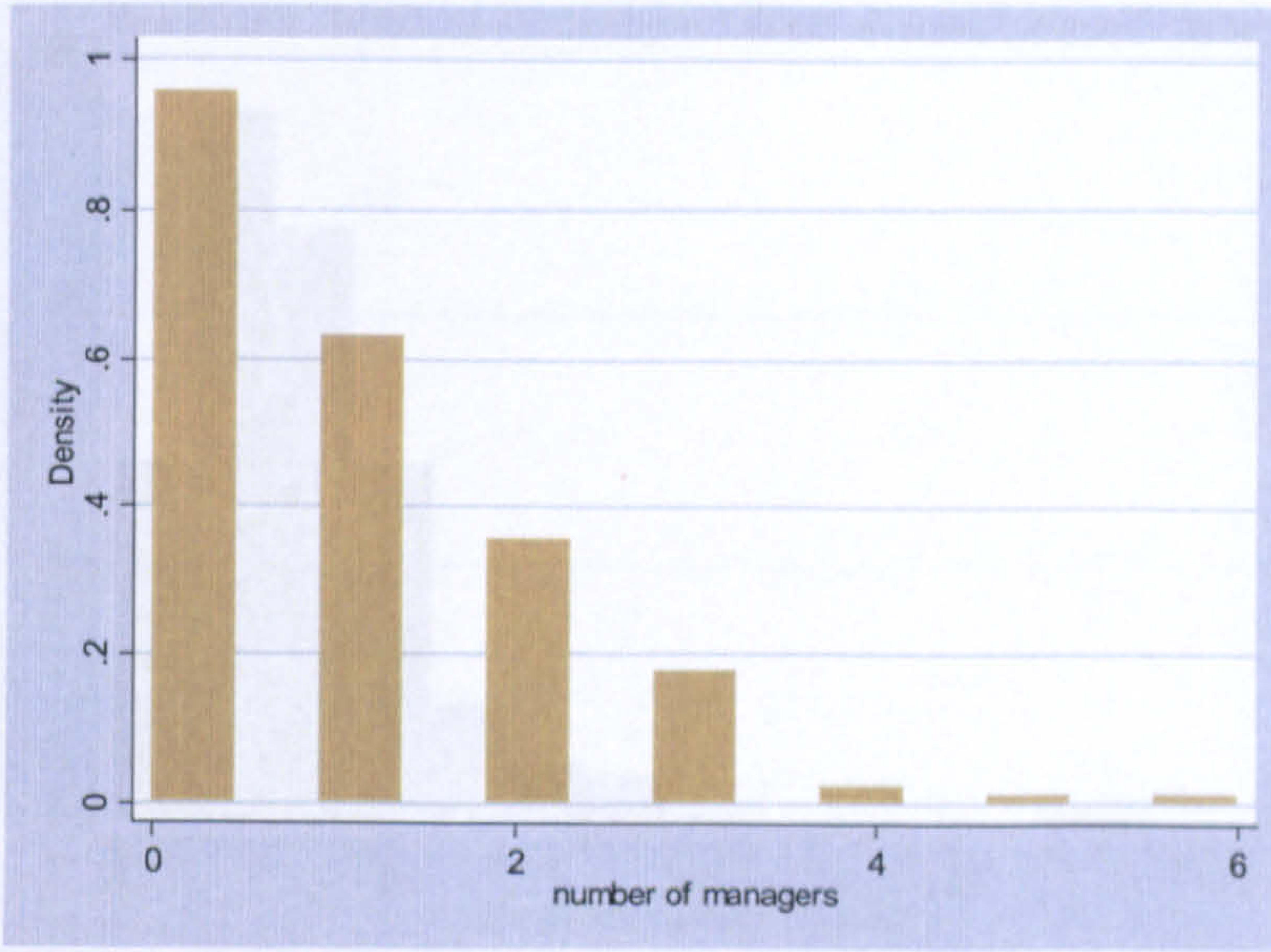

Figure 4.3: The cross-section distribution of the number of managers in the before 1999 NMW introduction balanced sample.

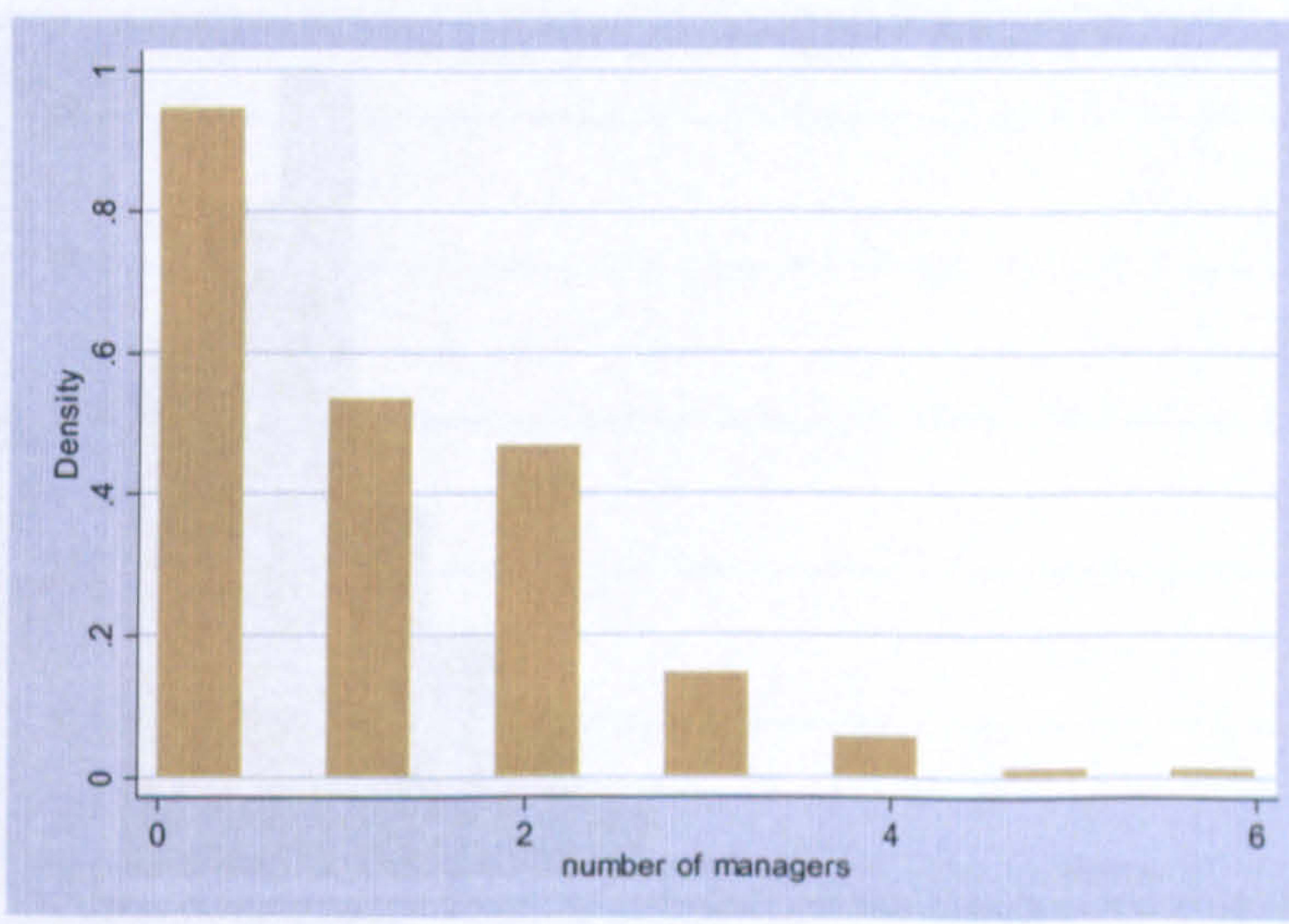

Figure 4.4: The cross-section distribution of the number of managers in the after 1999 NMW introduction balanced sample.

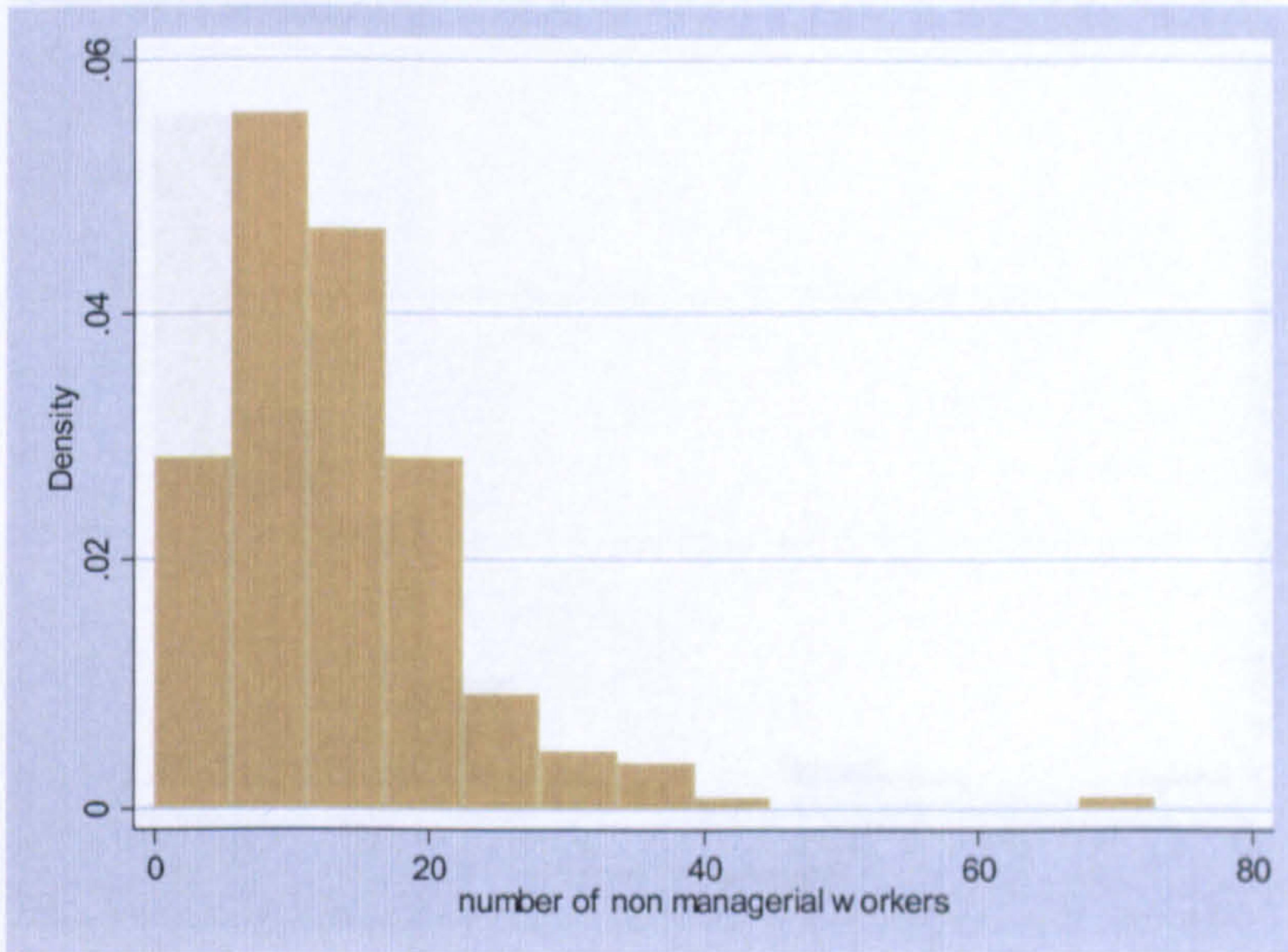

Figure 4.5: The cross-section distribution of the number of non managerial employees in the before 1999 NMW introduction balanced sample.

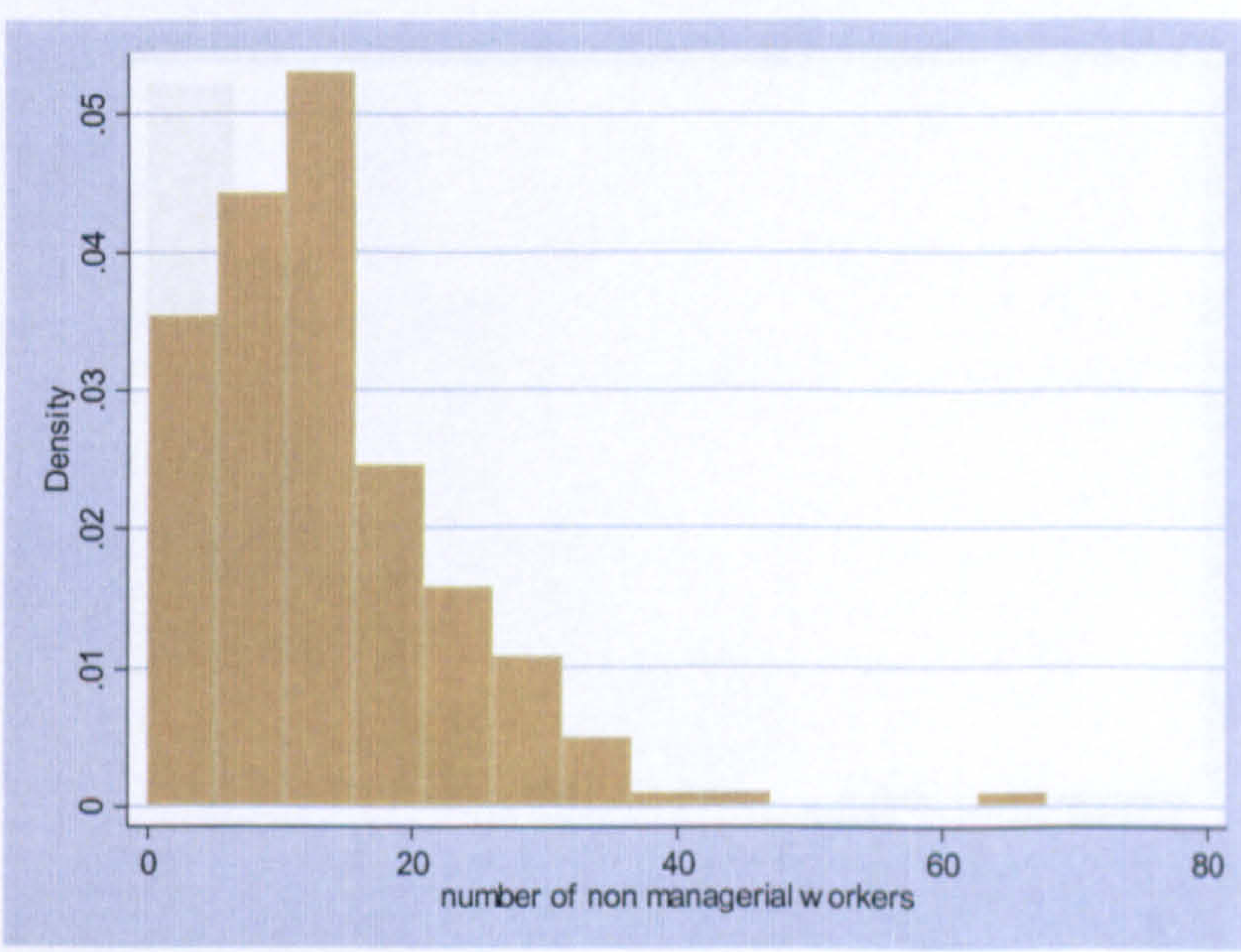

Figure 4.6: The cross-section distribution of the number of non managerial employees in the after 1999 NMW introduction balanced sample.

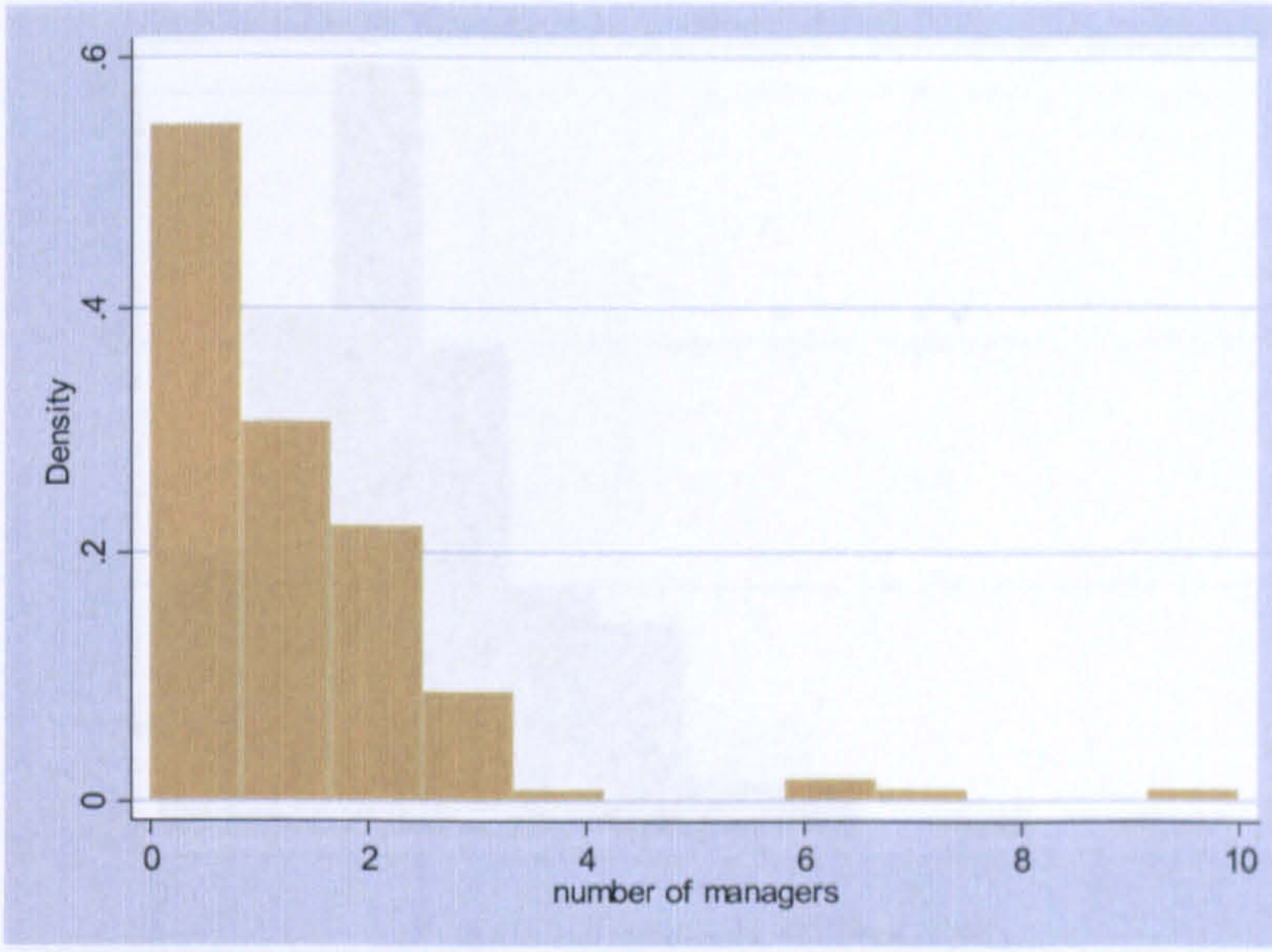

Figure 4.7: The cross-section distribution of the number of managers in the before 2001 NMW increase balanced sample.

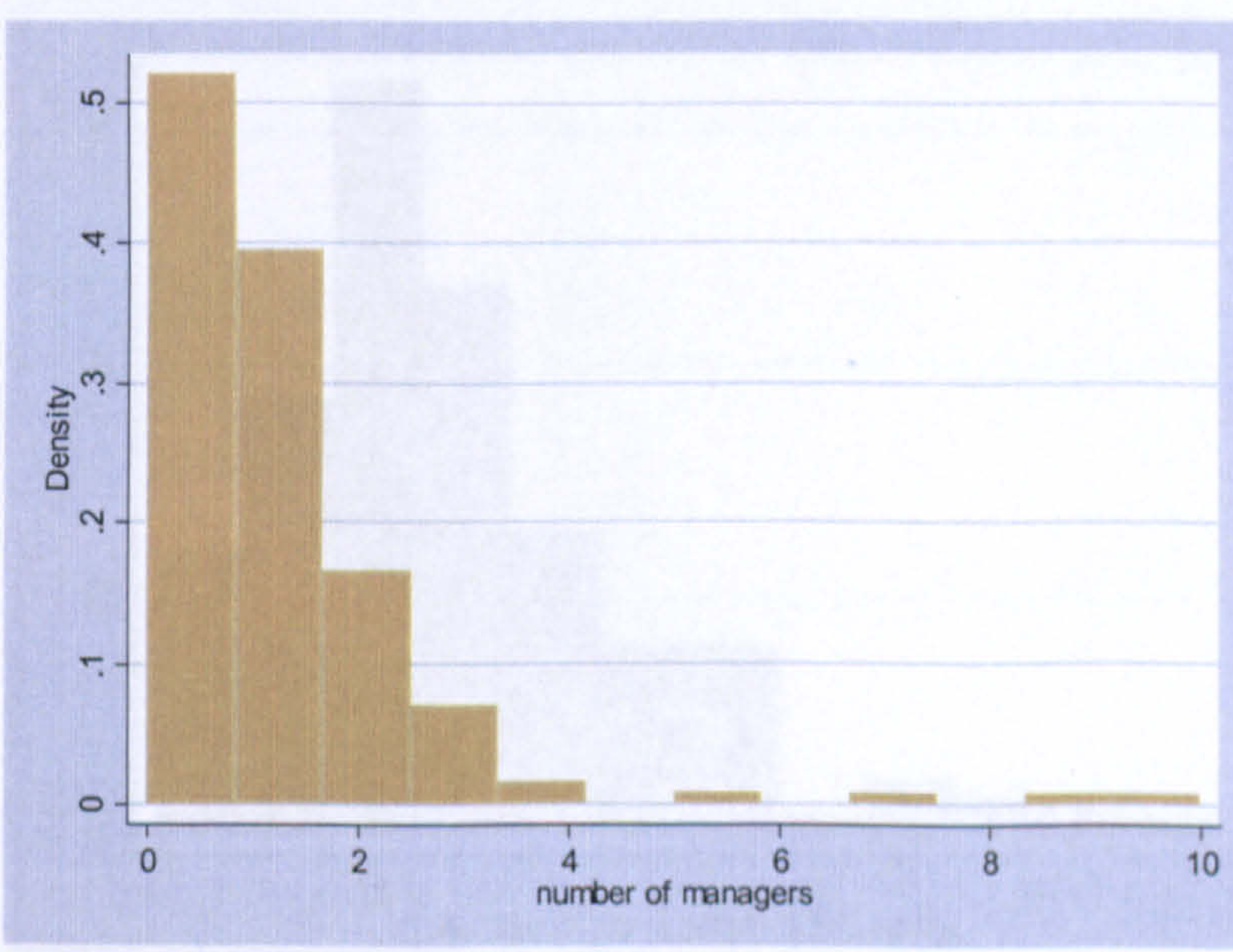

Figure 4.8: The cross-section distribution of the number of managers in the after 2001 NMW increase balanced sample.

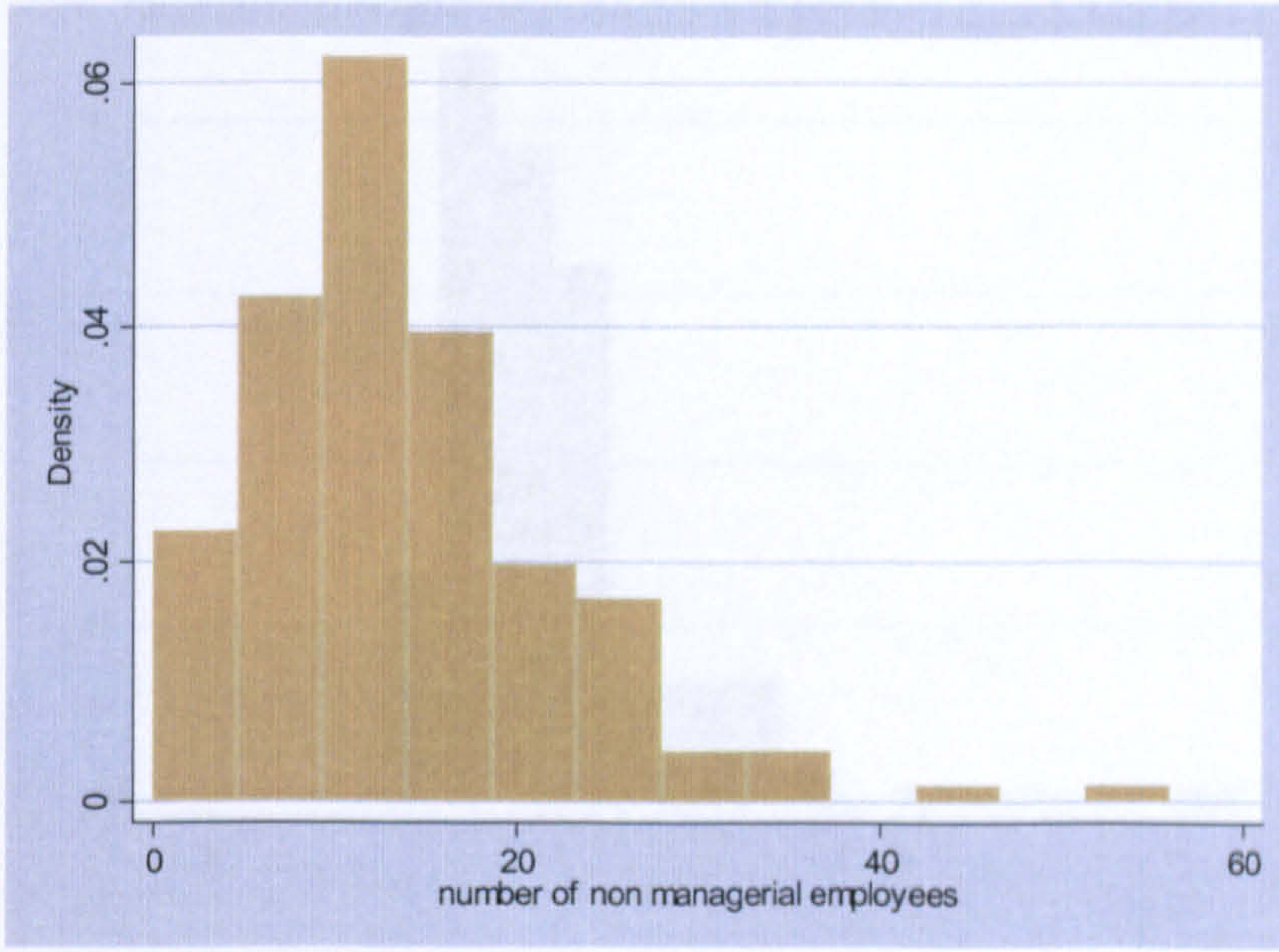

Figure 4.9: The cross-section distribution of the number of non managerial employees in the before 2001 NMW increase balanced sample.

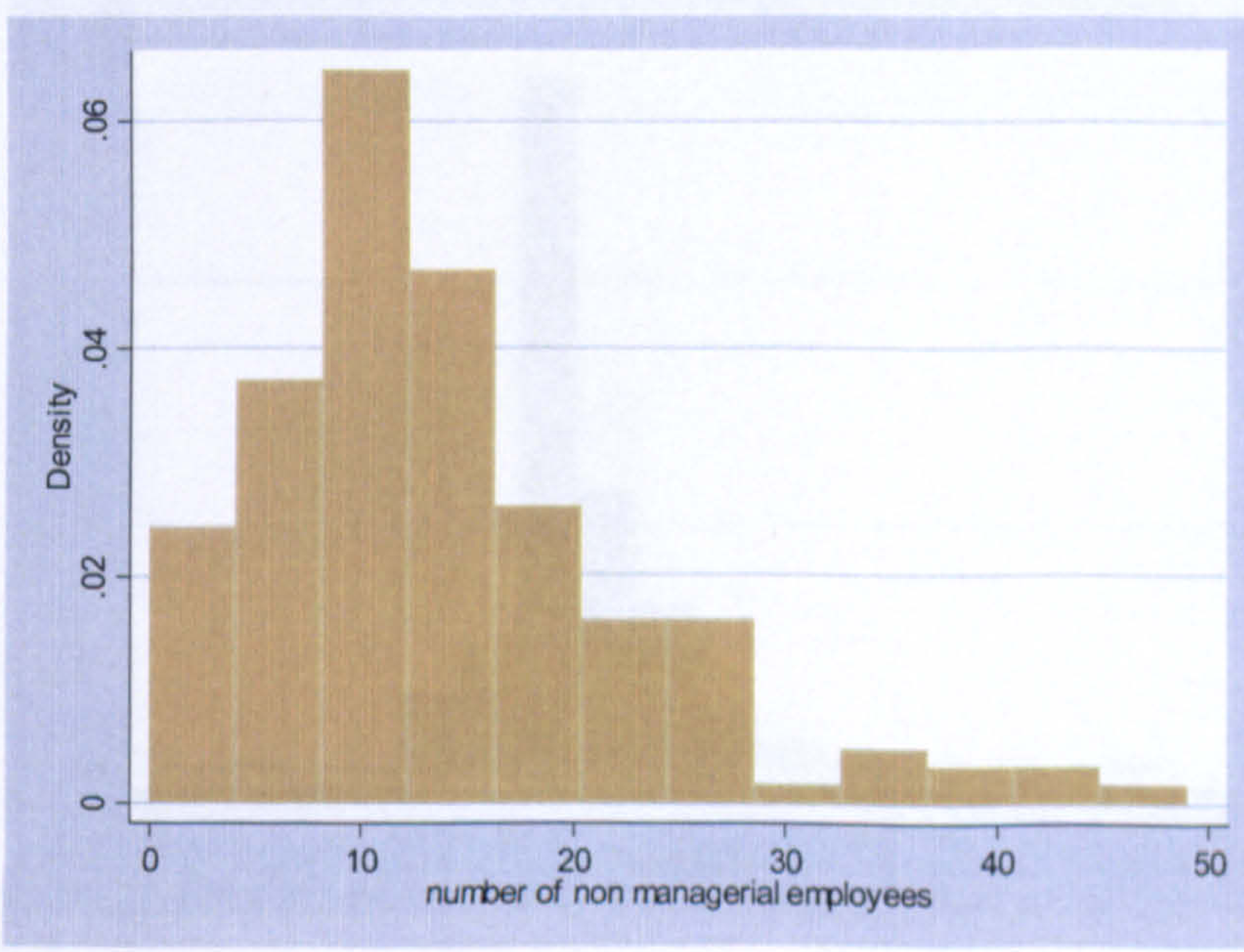

Figure4. 10: The cross-section distribution of the number of non managerial employees in the after 2001 NMW increase balanced sample.

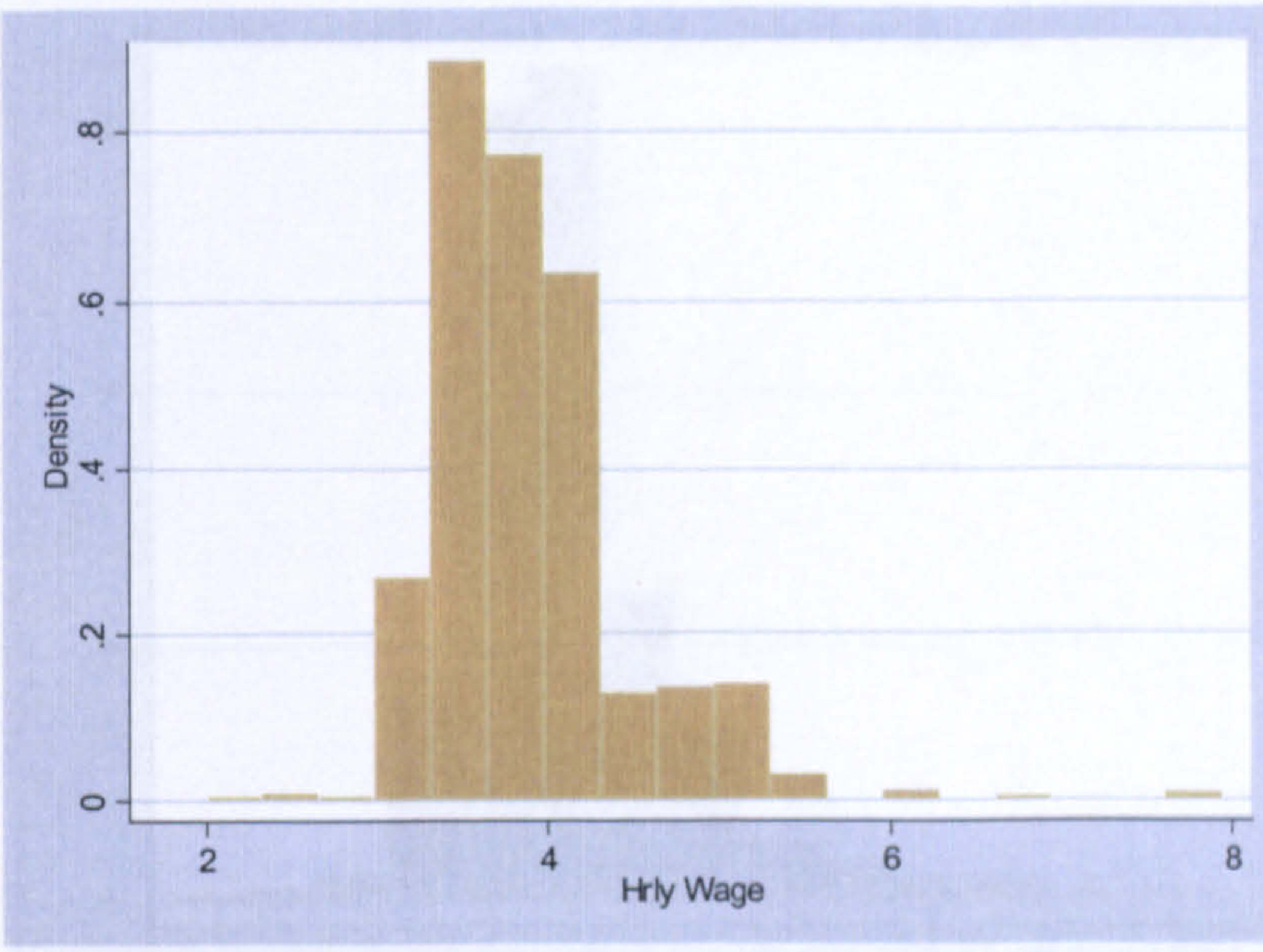

Figure 4.11: The distribution of hourly wages across workers covered by the development rate in the post-1999 NMW introduction..

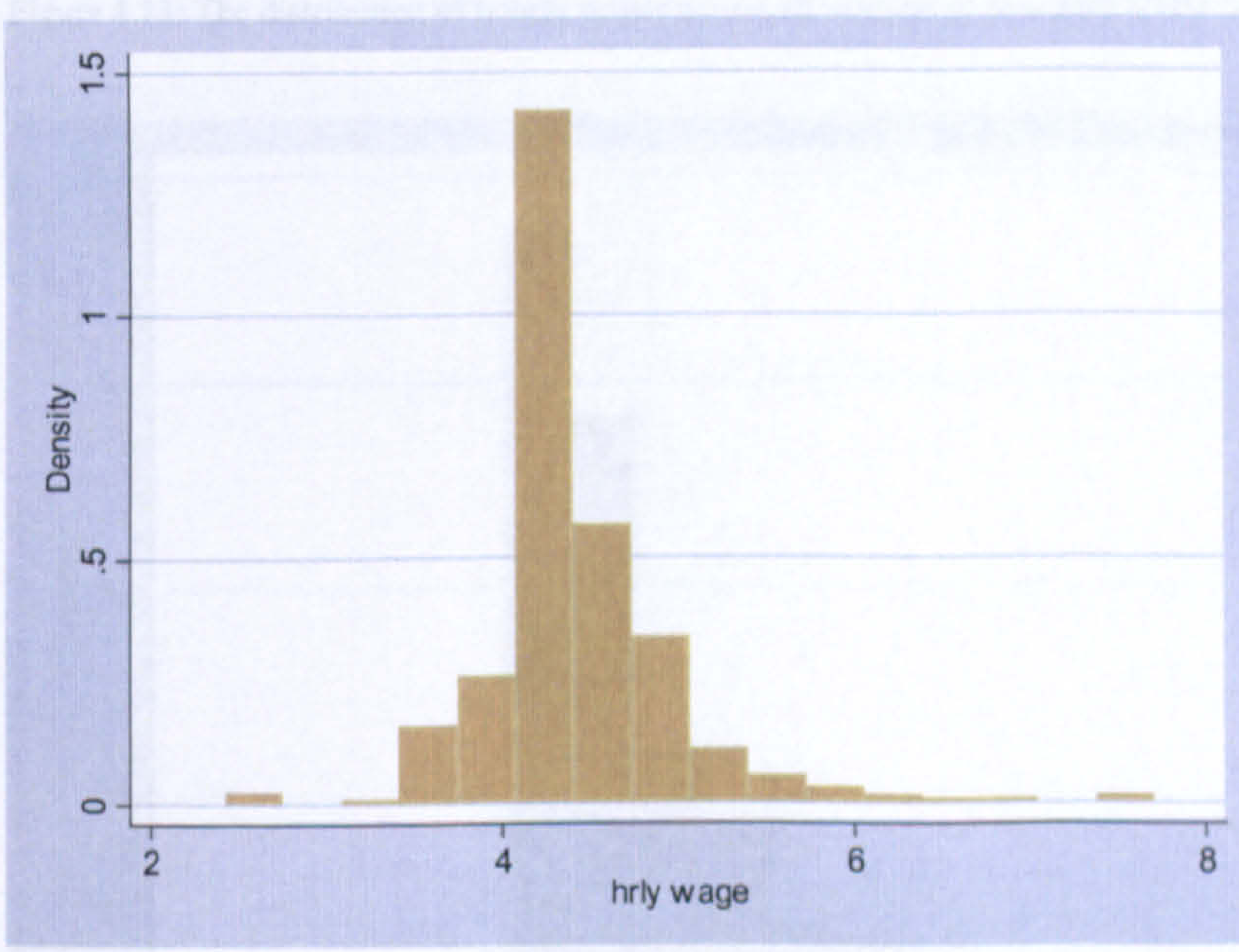

Figure4.12: The distribution of hourly wages across workers covered by the development rate in the post-2001 NMW increase.

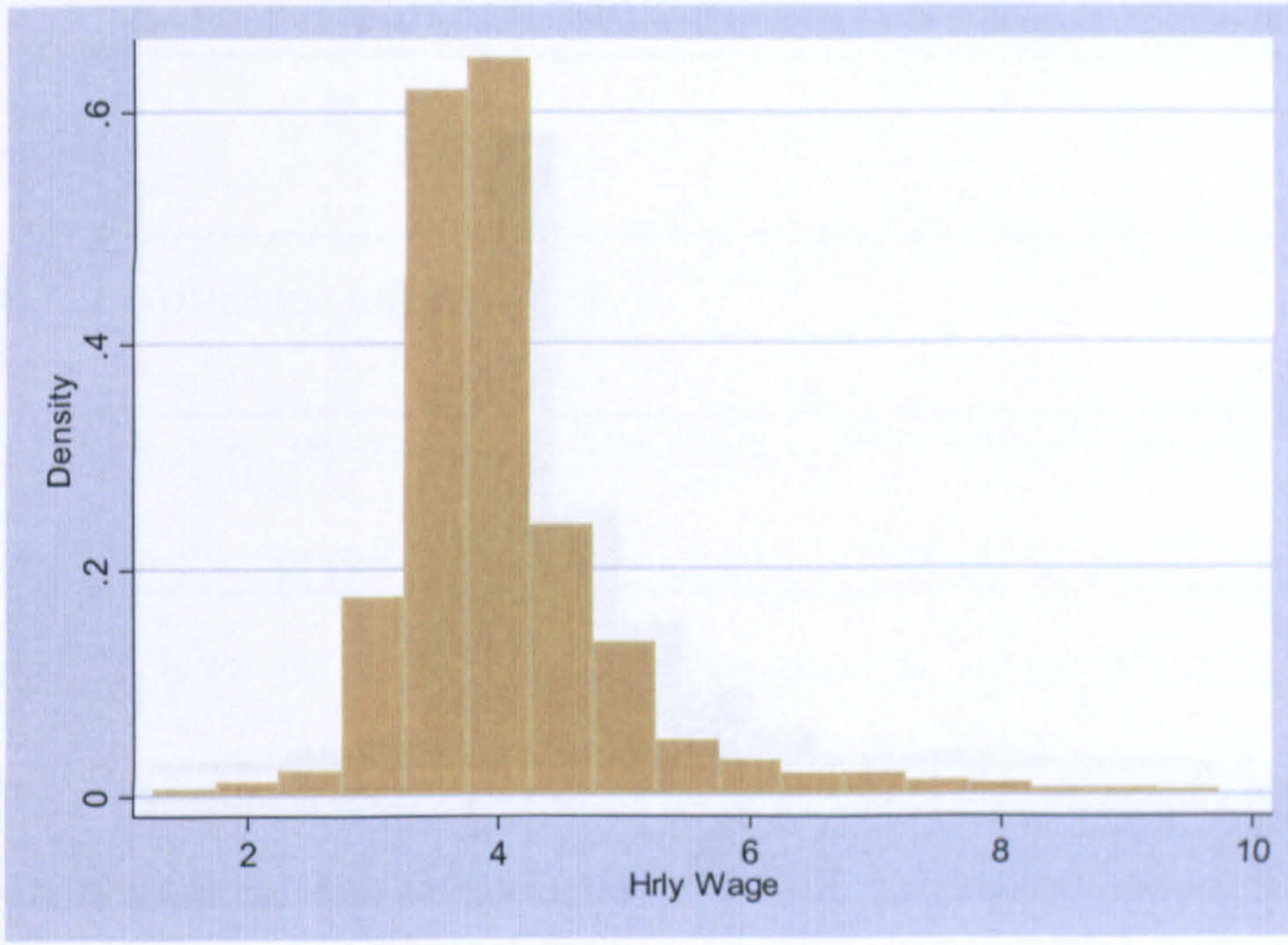

Figure 4.13: The distribution of hourly wages across all workers in pre-1999 NMW introduction survey.

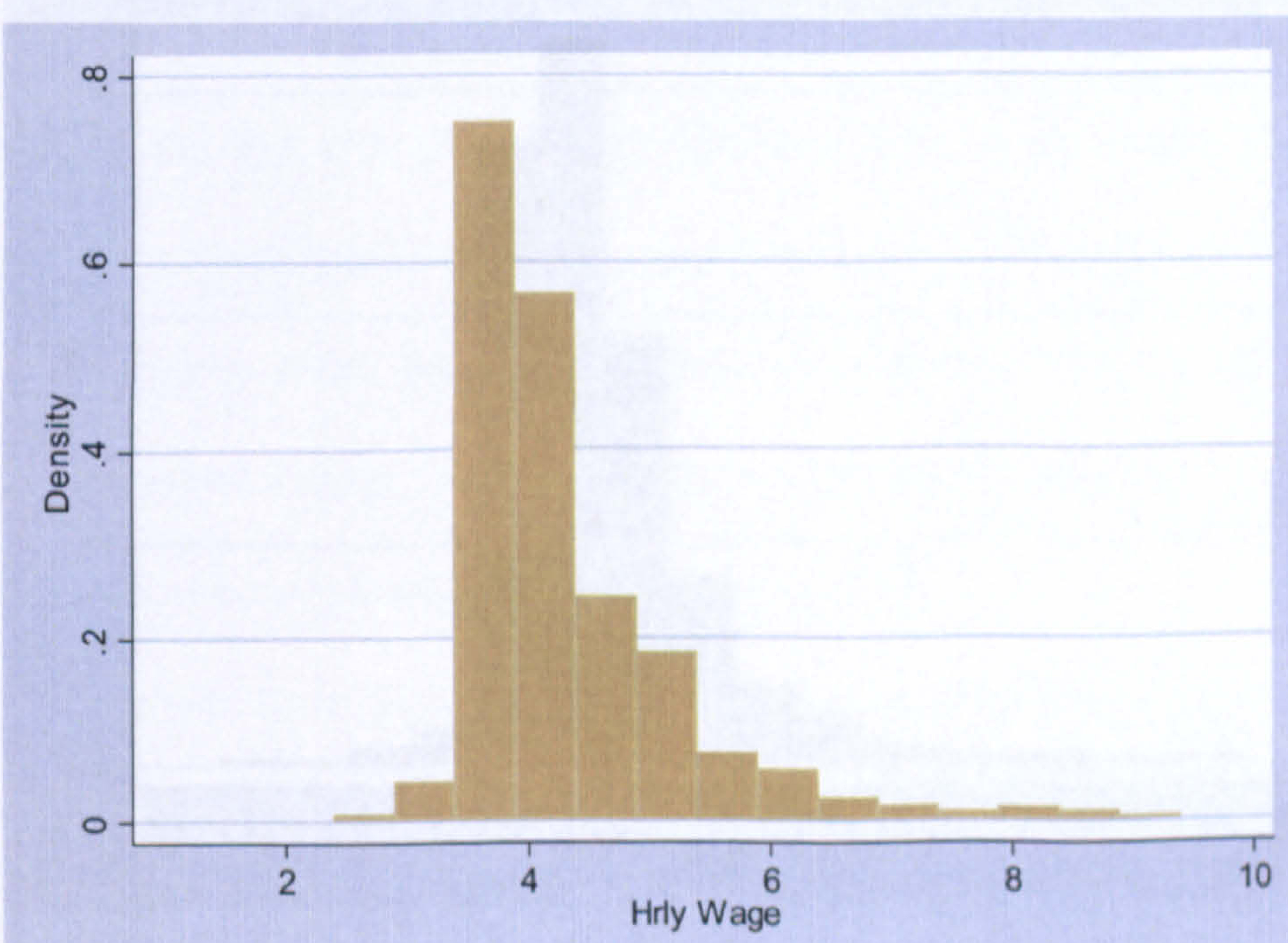

Figure 4.14: The distribution of hourly wages across all workers in post-1999 NMW introduction

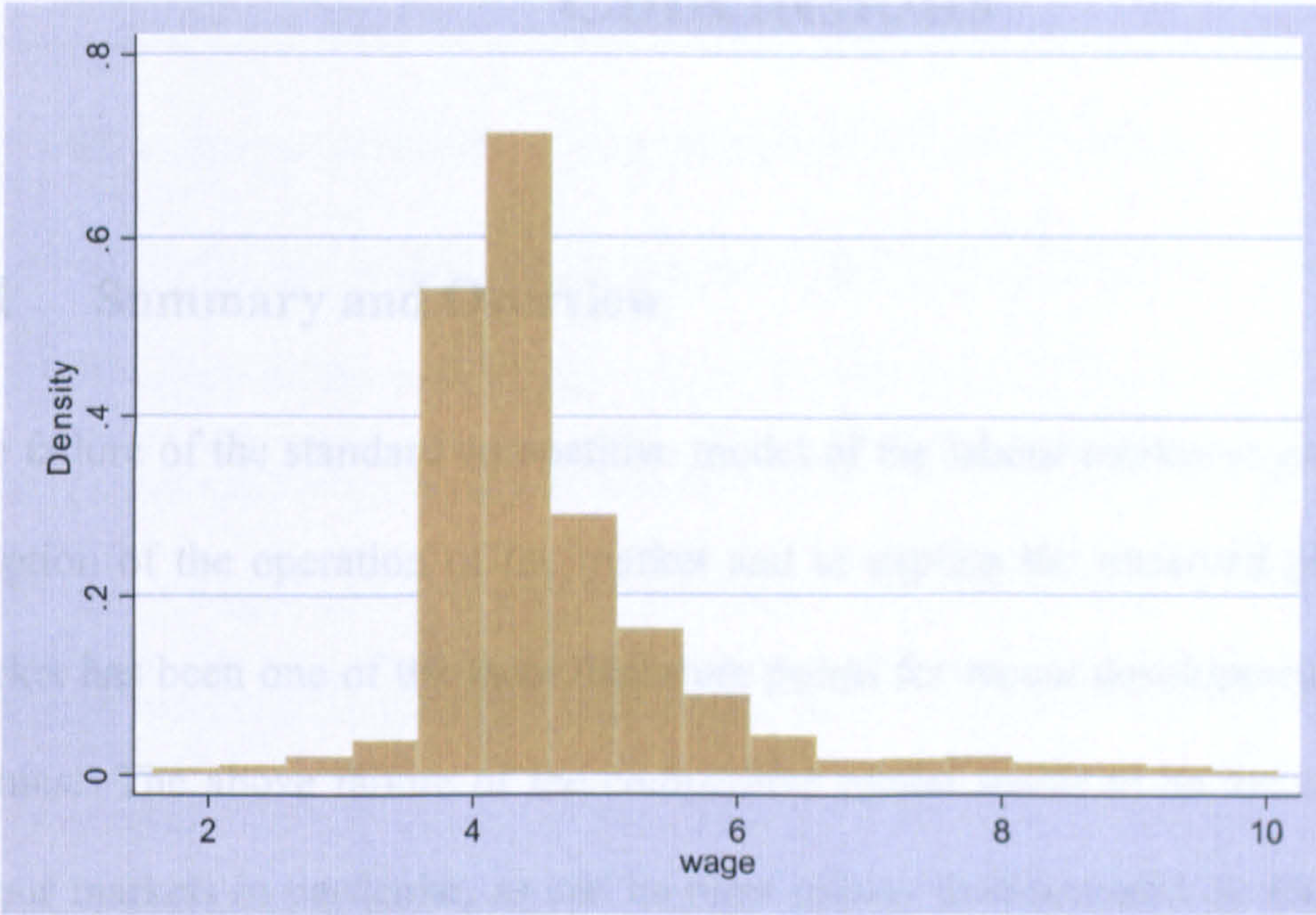

Figure 4.15: The distribution of hourly wages across all workers in pre-2001 NMW increase survey.

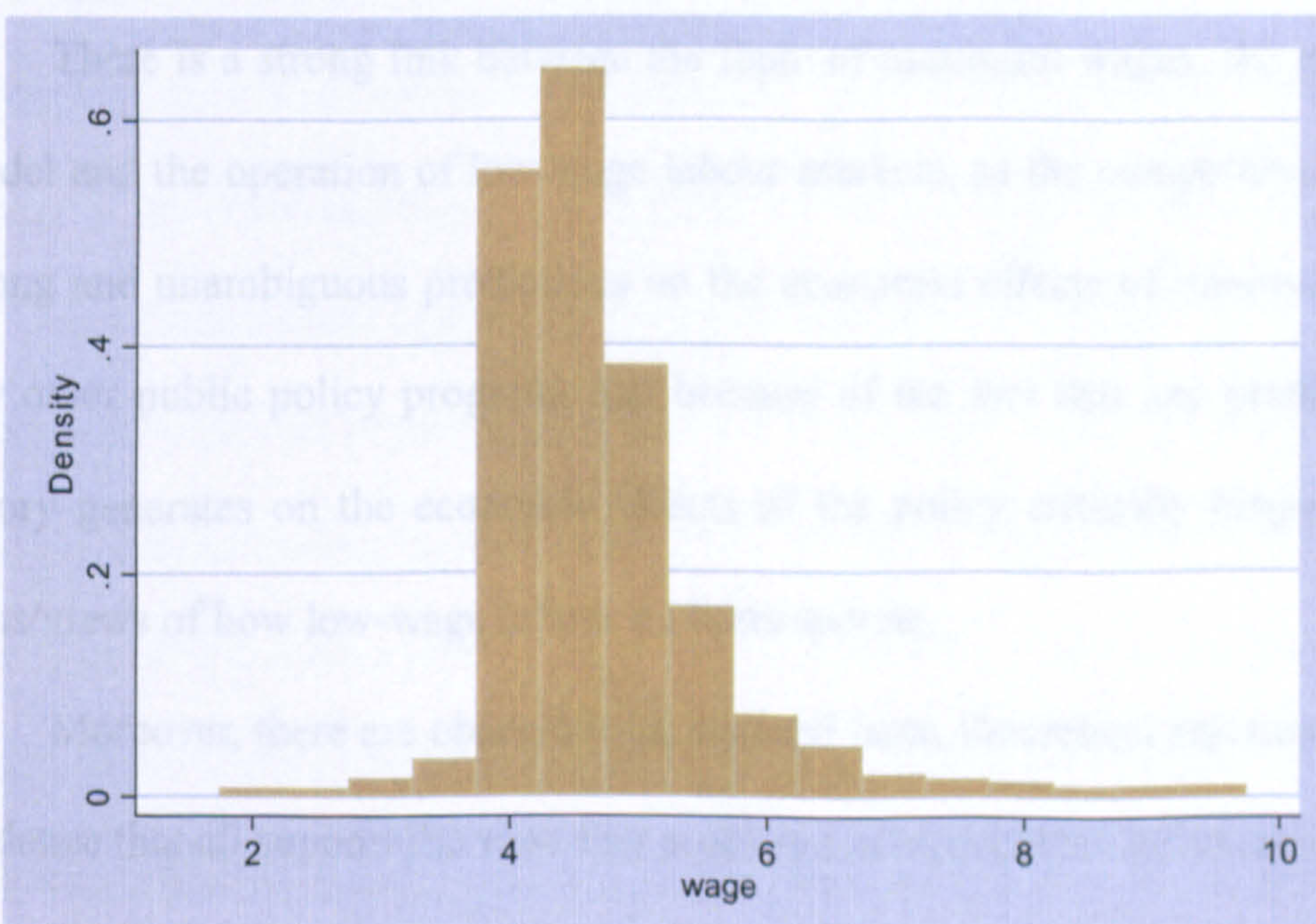

Figure 4.16: The distribution of hourly wages across all workers in post-2001 NMW increase survey.

Chapter 5
Conclusions

5.1 Summary and Overview

The failure of the standard competitive model of the labour market to provide a good description of the operation of the market and to explain the observed phenomena in the market has been one of the main departure points for recent developments in labour economics. The above failure of the competitive model seems to be the case in low-wage labour markets in particular, as can be most clearly demonstrated by the literature in the topic of minimum wages.

There is a strong link between the topic of minimum wages, the standard textbook model and the operation of low-wage labour markets, as the competitive model produces strong and unambiguous predictions on the economic effects of minimum wages, unlike any other public policy program, and because of the fact that any predictions economic theory generates on the economic effects of the policy critically hinge on the assumptions/views of how low-wage labour markets operate.

Moreover, there are observations, stylized facts, theoretical arguments and empirical evidence that all support the view that problems of asymmetric information, as agency and adverse selection problems, are a pervasive characteristic of all labour markets. There is also evidence and observations that suggest that there are significant barriers in low-wage labour markets that limit the implementation of efficient labour contracts, that are usually presented as the best response to asymmetric information problems.

The limitations in the implementation of first best contracts in low-wage labour markets, the failure of the neoclassical model to reconcile with empirical evidence and the evidence that supports a close link between efficiency and minimum wages open the door to efficiency wages as an alternative theoretical approach that can provide insight into the economic effects of minimum wages in particular and the workings of low-wage labour markets in general.

The latter analysis provides the motivation of the thesis that is engaged with the investigation of the validity of efficiency wages theory in low-wage labour markets and in particular the predictive power of the theory as far as the economic effects of minimum wages is concerned and thus the insight the theory can offer on labour markets operation.

The fundamental criterion to assess the validity of economic models is their ability to accurately predict observed phenomena. This is why we firstly address the hypothesis of interest by extending the seminal shirking efficiency wags model of Shapiro and Stiglitz (1984) used by Rebitzer and Taylor (1995) to predict the economic effects of the minimum wage and particularly its effects on employment of affected workers, one of the most heavily researched hypotheses in economics. The latter approach is further justified by the same arguments, presented above, that form the motivation for the thesis but also by the limitations of the seminal efficiency wages models used to predict the economic effects of the minimum wage.

Our main contribution is that we show that the fundamental prediction of the seminal efficiency wages models of the minimum wage, that a minimum introduction/increase may have a positive effect on employment hinges on simplified assumptions and does not hold if these assumptions are relaxed. In particular, we show that the prediction of the positive minimum employment effect of the model of Rebitzer and Taylor and the model of Calvo and Wellisz (1979) hinges on the assumption of fixed supervision and on the assumption of constant returns to scale respectively, and that the minimum wage employment effect becomes zero or negative under endogenous supervision and ambiguous under decreasing returns to scale. We also show that our extended model can better reconcile with recent empirical evidence on the employment effects of the minimum wage from low-wage labour markets, as it can more accurately explain the recent striking evidence of a zero or small negative employment effect of the minimum wage and reconciles in particular with the evidence produced by the exceptionally influential fast food studies that renewed the interest in the topic of minimum wages.

The theoretical analysis presented in chapter two, hinges critically on the assumption that there are important efficiency wages considerations in low-wage markets, where the minimum wage is binding. As it is as easy to make a theoretical case against efficiency wages as for them, evidence in support of the latter claim is also needed. The empirical investigation of the validity of efficiency wages theory is necessary in order to address the central hypothesis of the thesis also because there is no persuasive evidence on efficiency wages, as empirical studies of efficiency wages have been hindered by many problems that render the empirical investigation of efficiency wages theory exceptionally vexing.

Our empirical test is based on a test of the prediction of the standard shirking model of efficiency wages that in equilibrium, ceteris paribus, there is wage-supervision trade-off.

We find evidence that supports a positive endogeneity bias for unskilled manual workers that masks the wage supervision trade-off, which provides some support to efficiency wages, as the source of the bias is the omission of factors that are correlated with wages and supervision under the efficiency wage theory.

Another major finding is produced by evidence that supports a wage-supervision trade-off for unskilled manual workers. This evidence does not necessarily provide support to efficiency wages as there is a problem of observational equivalence because there are other than efficiency wages explanations of the trade-off. One of our contributions is that we develop another, novel explanation of the wage-supervision trade-off, which arises because of unobserved differences in union bargaining power, when there is firm-union bargaining over pay and supervision, and when unions prefer higher wages and lower intensity, as unions often not only negotiate over pay but also on working conditions and staffing levels, which are usually strongly correlated with supervision intensity.

We also provide an attempt to sort out efficiency wages and alternative explanations of a negative relationship between wages and supervision. The results seem to support the tenet of efficiency wages that wages and supervision are substitutes in eliciting effort and productivity by unskilled manual employees.

One of the main problems of the empirical literature of efficiency wages is that the majority of studies do not fully address the main empirical question in efficiency wages and thus provide weak evidence of efficiency wages, a result which is considered 'as good as it gets' (Autor 2003). Thus, as the evidence of the wage-supervision trade-off for unskilled manual employees can be also considered as weak evidence of efficiency wages, in order to fully address the hypothesis of interest we conduct a further test that investigates whether wages 'paid for themselves' and thus whether employers in the trading and non unionised sector where wages are set unilaterally, have been paying efficiency wages. The evidence produced by this latter test suggests that the payment of efficiency wages for unskilled manual workers cannot be ruled out in favour of alternative motivation devices.

The rest of the evidence produced on semi-skilled and skilled manual employees suggest a pattern of results that is consistent with the efficiency wage prediction of a positive bias. However, we fail to find further support for efficiency wages as we find no evidence of a wage-supervision trade-off for semi-skilled and skilled manual employees.

The evidence generated by this test of efficiency wages indicate that the wage-supervision trade-off is valid only for unskilled manual employees, although it may still hold for semi-skilled and skilled employees for which it is expected to be less pronounced. This interpretation of the main findings seems to provide support to the hypothesis that efficiency wages considerations are particularly relevant for less skilled, low-wage workers and thus may provide valuable insight into the workings of low-wage labour markets.

Although the latter test provides an attempt to investigate the validity of efficiency wages in general, in order to address the central hypothesis of the thesis in a more robust way it is important that we also look for evidence that may provide support to the ability of efficiency wages theory to predict the effects of the minimum wage as well as the validity of efficiency wages in low-wage labour markets in particular.

We test the latter hypothesis by exploiting the ideal research design offered by the recent introduction and subsequent increases of the UK National Minimum Wage (NMW) using data from the residential care homes industry a very low-wage sector that is very vulnerable to minimum wage increases. The research design offered by the NMW introduction/increase is ideal, as it allows us to address the main problems that are widely faced by the majority of empirical studies of efficiency wages, but also by our empirical test presented in chapter 3 and thus to identify more clearly the relationship between wages and supervision. This is because the NMW introduction an increase is an above market clearing wage setting (that is the essence of efficiency wages theory) and generates exogenous and independent variation in wages across care homes. Finally, this empirical setting also enables us to produce evidence on the effects of the minimum wage on employment and wages as well as on other outcomes, as prices, profits, productivity, and other long-run offsets, as substitution of production inputs, that allows as to draw a more complete picture of the effects of the policy in the labour market and that can be useful for the evaluation of the main theoretical approaches that have been employed in the analysis of minimum wages.

The main findings suggest that the 1999 NMW introduction and 2001 increase had a significant impact on care homes wages but a moderate effect on employment and output, considering the sizeable impact they had on the wage structure. The evidence also indicate that the 2001 NMW increase had as a result an increase in the average weekly average price of bed in care homes which further suggests that prices were not capped by local authorities, as it was the case for the 1999 NMW introduction.

In general we fail to find any evidence of significant offsets, in terms of output per employee or factor substitution as a response to the NMW introduction and increase or any other offsets in terms of turnover, employees quality and employees effort that would support some of the standard efficiency wages considerations in the care home sector. However, most importantly we do find evidence that the 1999 introduction had as a result a fall in the supervisor to staff ratio which further suggests that care homes managers reduced supervision intensity and thus supervision costs as a response to the NMW introduction, a finding which provides supports a prediction of the 'shirking' model as well as the main tenet of efficiency wages that above market clearing wages generate gains in terms of employees productivity.

Another test seems to suggest that the increase in wage costs generated by the minimum wage introduction is more likely to be exactly or more than offset by a fall in supervision costs. The latter finding, on the one hand may not suggest that care homes employers pay efficiency wages but on the other hand cannot rule out the interpretation that the minimum wage may have operated as an efficiency wage, which may further explain the moderate employment effects of the policy, provided the significant impact it had on the wage structure of the sector.

Moreover, an important finding is produced by the evaluation of the theoretical models of minimum wages that indicates that efficiency wage models can better reconcile with most of evidence on the effects of the NMW introduction and increase in the care homes sector, compared to the rest of theoretical models. This latter finding seems to provide some support to the hypothesis that minimum wages may have operated as an efficiency wage in the care homes sector and to the main hypothesis of the thesis that efficiency wages considerations are particularly relevant for low-wage labour markets and that is why efficiency wages theory can provide valuable insight on the economic effects of minimum wages and the operation of low-wage labour markets.

Our basic findings produce a number of interesting implications for the direction of future research on low-wage labour markets and for public policy. Firstly, the evidence produced by the analysis of the impact of the UK NMW in the care homes sector may seen as supporting the view that the adverse employment and welfare effects of minimum wages have been exaggerated (Brown 4.1988, Card and Krueger 4.1995, Zavodny 1999). If one takes also into account the evidence and views that the minimum wage reduces wage inequality, has no budgetary consequences and makes work pay and thus doesn't reduce labour force participation as other transfer programs, then he/she could further justify why minimum wages have recently become more popular for policy makers, despite the negative view held by economists. However, the main implication of the above reading of the evidence is the reorientation of policy discussions and of the bulk of future research from the efficiency aspects of the minimum wage towards distributional issues.

Our analysis indicates that our extended efficiency wages shirking model performs particularly well in predicting the employment effects of minimum wages in low-wage labour markets, and that efficiency wages models can reconcile with the main empirical evidence on the economic effects of minimum wages. An immediate implication of this may be that the same analysis could perform equally well in explaining the effects of other exogenous wage interventions in low-wage labour markets such as that exerted by unions.

However, this view is based on a standard textbook view that treats minimum wages and unions as very similar if not identical, as according to this view both institutions are seen as raising wages above the market-clearing level, reducing employment in the affected sectors.

However, under alternative models of the labour market minimum wages and trade unions are unlikely to have the same effect and thus the analysis of the two institutions is likely to be rather different (Manning 2003). In general, although our efficiency wages model seems rather effective in explaining the economic effects of the minimum wage, in order to suggest that it performs also well in providing insight in the operation of low-wage labour markets it is important that one also investigates its predictive power regarding other topics that are top priorities of the research agenda of low-wage labour markets. For example looking at the economic effects of trade unions under an efficiency wages point of view seems particularly interesting, as unions may also provide a similarly ideal setting, as that provided by minimum wages, to test the essence of efficiency wages that above market clearing wages generate benefits in terms of employees' productivity.

Finally, although the evidence presented here supports the tenet of efficiency wages that wages affect employees' productivity, future empirical work on efficiency wages and low-wage labour markets should also focus on the importance of motivation/incentive and adverse selection/sorting problems and of the related costs and the responsiveness of the above costs to higher wages, an issue which is of essence for the validity of efficiency wages considerations for the operation of low-wage labour markets.

The main objective of the thesis is to fill some of the gaps in the minimum and efficiency wages literature and provide further insight into the operation of low-wage labour markets, which still remains a mystery to economists. Provided that my attempt can be considered as successful in providing even the minimum of insight, I consider this as the best reward to the effort and energy expended.

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